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4265A
Binary Programmable Power Source

Instruction Manual

FLUKE®

4265A

Binary Programmable Power Source

Instruction Manual

P/N 310631
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Rev. 2 5/79

FLUKE®

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WARRANTY

Notwithstanding any provision of any agreement the following warranty is exclusive:

The JOHN FLUKE MFG. CO., INC., warrants each instrument it manufactures to be free from defects in material and workmanship under normal use and service for the period of 1-year from date of purchase. This warranty extends only to the original purchaser. This warranty shall not apply to fuses, disposable batteries (rechargeable type batteries are warranted for 90-days), or any product or parts which have been subject to misuse, neglect, accident, or abnormal conditions of operations.

In the event of failure of a product covered by this warranty, John Fluke Mfg. Co., Inc., will repair and calibrate an instrument returned to an authorized Service Facility within 1 year of the original purchase; provided the warrantor's examination discloses to its satisfaction that the product was defective. The warrantor may, at its option, replace the product in lieu of repair. With regard to any instrument returned within 1 year of the original purchase, said repairs or replacement will be made without charge. If the failure has been caused by misuse, neglect, accident, or abnormal conditions of operations, repairs will be billed at a nominal cost. In such case, an estimate will be submitted before work is started, if requested.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS, OR ADEQUACY FOR ANY PARTICULAR PURPOSE OR USE. JOHN FLUKE MFG. CO., INC., SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER IN CONTRACT, TORT, OR OTHERWISE.

If any failure occurs, the following steps should be taken:

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2. On receipt of the shipping instructions, forward the instrument, transportation prepaid. Repairs will be made at the Service Facility and the instrument returned, transportation prepaid.

SHIPPING TO MANUFACTURER FOR REPAIR OR ADJUSTMENT

All shipments of JOHN FLUKE MFG. CO., INC., instruments should be made via United Parcel Service or "Best Way"* prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid and of adequate size. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT TO ORIGINAL PURCHASER

The instrument should be thoroughly inspected immediately upon original delivery to purchaser. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument is damaged in any way, a claim should be filed with the carrier immediately. (To obtain a quotation to repair shipment damage, contact the nearest Fluke Technical Center.) Final claim and negotiations with the carrier must be completed by the customer.

The JOHN FLUKE MFG. CO., INC, will be happy to answer all applications or use questions, which will enhance your use of this instrument. Please address your requests or correspondence to: JOHN FLUKE MFG. CO., INC., P.O. BOX C9090, EVERETT, WASHINGTON 98206, ATTN: Sales Dept. For European Customers: Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands.

*For European customers, Air Freight prepaid.

John Fluke Mfg. Co., Inc., P.O. Box C9090, Everett, Washington 98206

Rev. 6/81

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Table 1-1. OPTIONS

OP-TIONS	TITLE	DESCRIPTION
–01	ISOLATED CONTROL LOGIC (Now Standard)	Separates the external digital interface logic and attendant noise from the Model 4265A analog circuitry. Impedance between the interface logic and the analog circuitry is greater than 10^9 ohms, in parallel with 3 pf. It also provides a data storage that allows multiplexing of several voltage sources from one system interface register or data bus. Two's complement binary coding is required for negative outputs.
–02	FRONT PANEL DISPLAY (Now Standard)	Lamps (light emitting diodes) installed on the front panel which indicates the programmed VOLTAGE LEVEL, SIGN, CURRENT LIMIT, EXT REF, POWER ON, and STDBY conditions.
–03	EXTERNAL REFERENCE (Field Installable)	Allows the use of an external signal source in place of the internal reference voltage. Any dc or ac signal can be used that has an amplitude from 0 to ±14.5 volts and a frequency from dc to 30 kHz. Input impedance is 100K, in parallel with 70 pf.
–04	DIRECT COUPLED CONTROL LOGIC (No Longer Available)	The Direct Coupled Control Logic is no longer offered as an option to the 4200 series instruments. The Isolated Control Logic (see description above) is now standard equipment on all instruments.
–05	BLANK FRONT PANEL (No Longer Available)	The Blank Front Panel is no longer offered as an option to the 4200 series instruments. The Front Panel Display (see description above) is now standard equipment on all instruments.
–06	PROGRAMMABLE CURRENT LIMITING (Field Installable)	Programmable current limit is provided in two ranges, 100 ma and 1 ampere. Each range may be programmed in 10% increments from 10% to 110% of range.
–09	MULTI-STROBE ISOLATED LOGIC (Field Installable)	Permits any of the Fluke 4200 series Programmable Voltage Sources to be remotely controlled by a large variety of program sources such as a computer, a system coupler, as well as a Fluke Automatic Test Equipmetn System. Refer to Section 6 for details.

1-6. SPECIFICATIONS

OUTPUT VOLTAGE . . . . . 0 to ±16.383 vdc
0 to ±65.532 vdc
(Maximum output terminal voltage = ±66v minimum)

OUTPUT VOLTAGE RESOLUTION . .
16v Range . . . . . 1.0 mv
65v Range . . . . . 4 mv
(Provisions have been made to allow changing of the MSB weight to 8000 and 32000 mv by installation of a jumper in the Preamplifier.)

Section 1

Introduction & Specifications

1-1. INTRODUCTION

1-2. The Model 4265A is a programmable, bipolar dc voltage source. Output voltage is from 0 to 65.532 vdc in two ranges; 16 and 65 vdc. Programming resolution using the internal reference voltage is 1 mv on the 16 volt range and 4 mv on the 65 volt range. Output accuracy is ±.01% of the programmed level on both voltage ranges. After a 100 μsec settling time, a READY/NOT READY FLAG indicates that the output has settled to ±.01% of the programmed increment for a resistive load. The output current is rated at ±1 ampere maximum and is limited to approximately ±1.1 ampere in the event of an overload or short circuit. The sink current (milliamps) is rated at 1000-10 E_{OUT} maximum. A Programmable Current Limiter (Option −06) is available to allow programming the maximum output current to a lower level. A current limit flag indicates when a sink or source current overload exists with or without the −06 Option.

1-3. Programming requirements are compatible with DTL or TTL logic levels. Contact or relay closures can also be used. The voltage source is programmed on the low range using straight binary coding. The high range is also programmed in the same manner, but the actual output is four times the programmed level. Two's complement coding is required for negative outputs when the Isolated Control Logic (−01 Option) is installed. All programming inputs and flag outputs are available through a 50 pin Amphenol, Blue Ribbon connector located on the rear panel. A +5 vdc output is also available at this connector and is used to provide power for external programming circuitry. Negative logic is employed for programming. The logic levels are as follows:

Logic "0" = +2.0 vdc to +5.0 vdc or open circuit
Logic "1" = 0 to +0.4 vdc or short circuit to LOGIC GRD.

1-4. Three options are available to provide tailoring of the power supply to fit application requirements. These options are identified by numeric designations −03, −06, and −09. A description of each option is provided in Table 1-1. These options may be installed at the factory when the instrument is ordered or in the field at a later time.

1-5. Physically, the power source is completely solid state. Plug in printed circuit boards, with easy to reach test points and adjustments, are used for ease in servicing. The unit is forced air cooled. This results in lower component temperatures and thus higher reliability than would normally be obtained in a source of this power capability. The chassis is designed for bench top use, or it can be installed in a standard equipment rack by using the Accessory Rack Mounting Fixtures.

OUTPUT CURRENT	0 to ±1 ampere (Short circuit protected at 1.1 ampere)
CURRENT SINK CAPABILITY	I_{SINK} (ma) = 1000 – 10 E_{OUT} (Overload protected) The Current Limit Flag is energized when a current sink overload condition occurs.
ACCURACY (15°C to 35°C, 90 days)	
16v Range	±(0.01% of program +100 uV)
65v Range	±(0.01% of program +300 uV)
STEADY STATE RIPPLE AND NOISE (10 Hz to 10 MHz bandwidth) 16v Range	500 uV rms 7mV p-p
65v Range	1 mV rms 7mV p-p
OUTPUT IMPEDANCE	0.02 milliohms @ dc; 1 ohm @ 30 kHz
EXTERNAL REFERENCE (Option –03)	
Voltage Range	0 to ±14.5 VDC or peak ac
Input Impedance	100k ohms in parallel with 70 pf
Output Voltage	
16v Range	0 to 12v rms, 17V peak
65v Range	0 to 46v rms, 66V peak
Output Current	707 ma rms, 1.0 amp peak
Frequency Range	dc to 30 kHz
Accuracy (15°C to 35°C, 90 days with respect to the External Reference, E_{XR}) 16v Range	$\pm(0.01\% \text{ of program} + .0001\%\left(\frac{75}{E_{XR}}\right) + 100 \text{ uV})$ at dc.
65v Range	$\pm(0.01\% \text{ of program} + .0001\%\left(\frac{75}{E_{XR}}\right) + 300 \text{ uV})$ at dc.
Programming Resolution (Least significant bit)	
16v Range	$E_{XR} \times 10^{-4}$ volts
65v Range	$E_{XR} \times 4 \times 10^{-4}$ volts
PROGRAMMABLE CURRENT LIMIT (Option –06)	
100 ma Range	±10 mA to ±110 mA in 10 mA increments
1 amp Range	±100 mA to ±1.1 amp in 100 mA increments
Minimum program possible	±10 mA
SPEED	Settles to 0.01% of the programmed change in 100 μsec. A range change does not increase settling time.
OUTPUT STABILITY (Constant load, line and temperature)	
16v Range, 24 hours	±(10 ppm of program + 40 uv)
90 days	±(30 ppm of program + 70 uv)
65v Range, 24 hours	±(10 ppm of program +120 uv)
90 days	±(30 ppm of program +210 uv)
TEMPERATURE COEFFICIENT (35°C to 15°C)	
16v Range	±(10 ppm of program +15 uv) per °C
65v Range	±(10 ppm of program +15 uV) per °C
LOAD REGULATION	An output current change of 1 ampere causes the output voltage to change less than 0.001% of range.
LOAD RECOVERY	The output voltage will settle to within 0.01% of final value in 100 μsec after an output current change of 1 amp.

LINE REGULATION	The output voltage will change less than 0.001% of range for a ±10% change in line voltage.
OUTPUT TERMINALS	HIGH, LOW, HIGH SENSE, LOW SENSE, CHASSIS, GUARD. Terminals located on rear panel. The GUARD terminal can be floated up to 1000 volts above chassis ground.
PROGRAM CONTROL CONNECTOR (See Table 1-3)	A 50 pin connector on rear panel. Mating connector is Amphenol, Blue Ribbon, Part No. 57-30500.
INPUT POWER	115/230 vac ±10%, 48–62 Hz single phase, 200 watts fully loaded.
ENVIRONMENTAL	
Temperature	0°C to 50°C operating; –40°C to 75°C storage.
Relative Humidity	0 to 80%
Shock	20g, 11 millisecond half-sine wave
Vibration	4.5g, 10–55 Hz
Altitude	0 to 10,000 ft - Operating 50,000 ft – Non-operating
SIZE (See Figure 1-1)	5–1/4" high x 17" wide x 19–7/8" (max) deep
ACCESSORIES	
Manual Control Unit	Allows manual checkout, calibration, and control. FLUKE Model A4200.
Rack Mounting Brackets	M05-205-600
Chassis Slides	M00-260-610 (18") M00-280-610 (24")
Mating Connector	Amphenol, Blue Ribbon 57-30500, FLUKE PART NO. 266056.
Extender Card	FLUKE PART NO. 292623

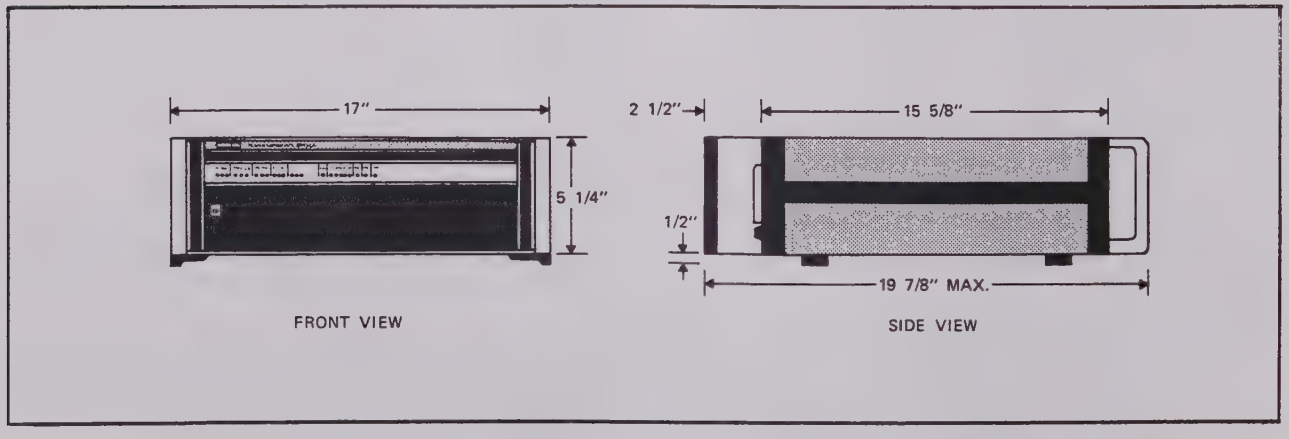


Figure 1-1. OUTLINE DRAWING

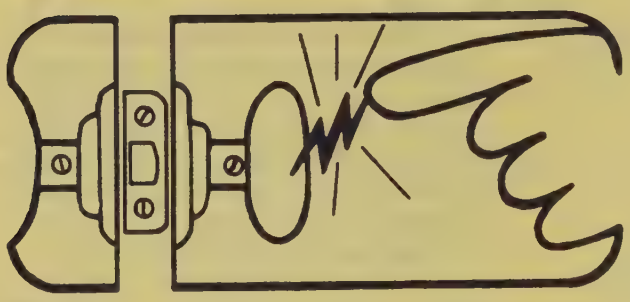
Table 1-2. PROGRAMMING INPUT/OUTPUTS

PROGRAM CONTROL	All program control and response lines are compatible with DTL and TTL logic. Programming lines are brought out on the rear panel.
LOGIC LEVELS	Logic "1" = 0 ±.4 vdc or contact closure. Logic "0" = +2 to +5 vdc or open circuit
SIGN	Connector Pin 35. Logic "1" = Negative output voltages
MAGNITUDE	Bit Wt. / Conn. Pin: 2^{13} 1; 2^{12} 2; 2^{11} 3; 2^{10} 4; 2^{9} 5; 2^{8} 6; 2^{7} 7; 2^{6} 8; 2^{5} 9; 2^{4} 10; 2^{3} 11; 2^{2} 12; 2^{1} 13; 2^{0} 14. *Two's complement binary coding for negative values is used with the Isolated Control Logic Option –01. Sign and magnitude binary coding is used with the direct coupled control logic Option –04.*
DATA STROBE	Connector pin 33. When using the Isolated Control Logic, a strobe pulse is required to start the digital-to-analog conversion process after a valid command is present. Minimum pulse width is 500 nanoseconds. A negative leading slope (+5V to OV transition) is required. Upon release of the Data Strobe, the output will go to the programmed value. If the Data Strobe is not used in the Direct Coupled mode, the output will follow any command data perturbations. Logic "1" = "hold" condition.
RANGE	Connector Pin 29; Logic "0" = Low Voltage Range, Logic "1" = High Voltage Range.
EXTERNAL REFERENCE	Connector Pin 36; Logic "0" = Internal DC Reference, Logic "1" = External Reference.
STANDBY	Connector Pin 34; Logic "0" = Operate Mode, Logic "1" = Standby; Output is approximately 1% of programmed level.
CURRENT LIMIT	Connector Pin 42: Function Range, Logic "1" 1 Amp, Logic "0" 100 mA. Pin 43: Magnitude, 80% of Range, 0. Pin 44: Magnitude, 40% of Range, 0. Pin 45: Magnitude, 20% of Range, 0. Pin 46: Magnitude, 10% of Range, 0. All "0"'s = 10% of range
RESPONSE SIGNALS	
CURRENT LIMIT FLAG	Connector Pin 49; Logic "1" represents a current overload condition.
READY/NOT READY FLAG	Connector Pin 37; Logic "0" = "Ready" condition; the output is within 0.01% of the programmed increment for a resistive load. Logic "1" = "Not Ready" condition; the power source is in the process of settling to the programmed value.
POWER CONNECTIONS	Connector Pin 25; An internal, isolated power supply furnished +5 vdc, current limited by 2.7 ohms, for use by the external system interface logic.
LOGIC GROUND	Connector Pins 17 thru 24; It is recommended that a large ground strap be used between the interface logic and the power source to reduce the digital programming noise on the system ground.

static awareness

A Message From

John Fluke Mfg. Co., Inc.

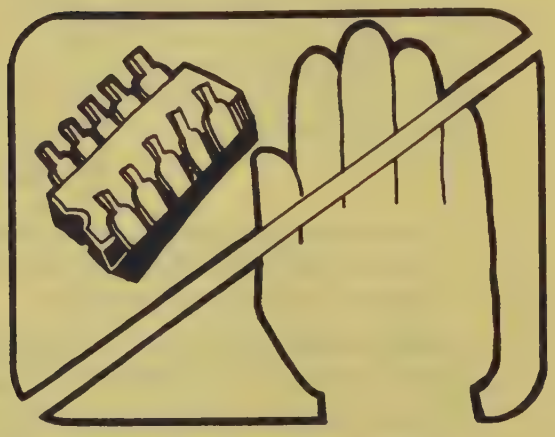


Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

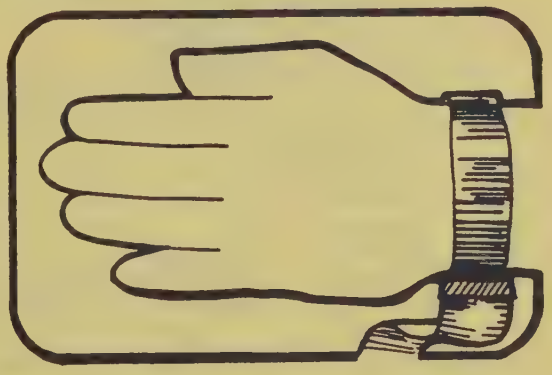
1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol "⊗"

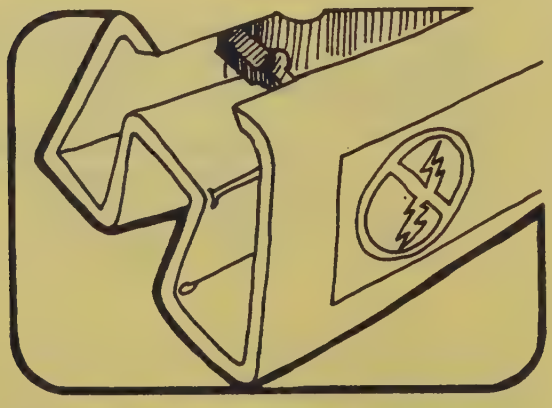
The following practices should be followed to minimize damage to S.S. devices.



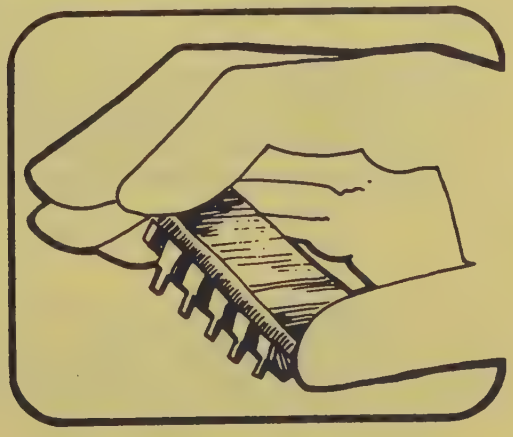
1. MINIMIZE HANDLING



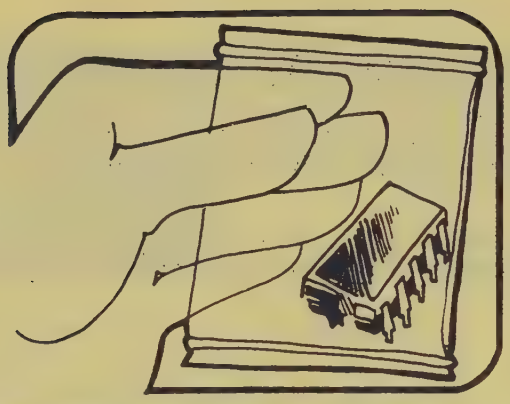
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES. USE A HIGH RESISTANCE GROUNDING WRIST STRAP.



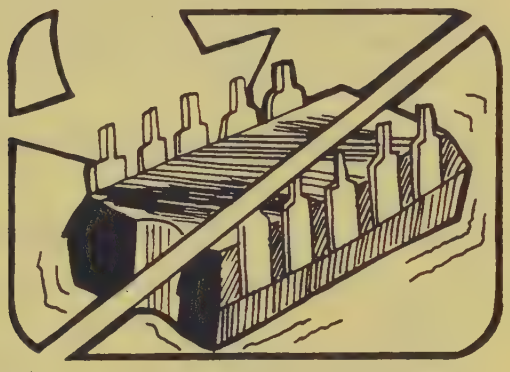
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



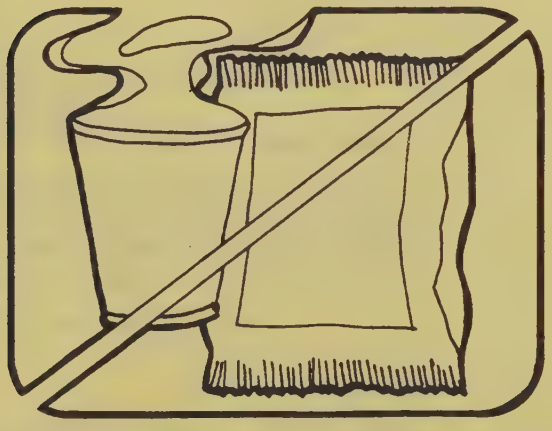
4. HANDLE S.S. DEVICES BY THE BODY



5. USE STATIC SHIELDING CONTAINERS FOR HANDLING AND TRANSPORT



6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE



7. AVOID PLASTIC, VINYL AND STYROFOAM® IN WORK AREA

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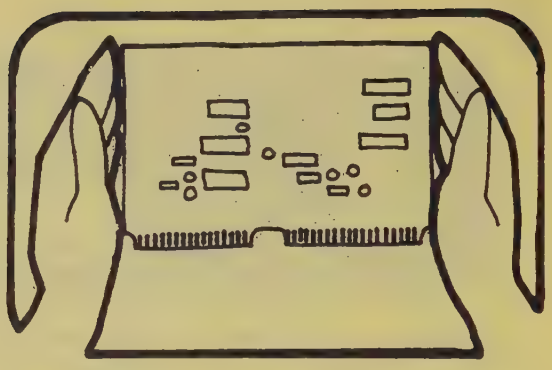
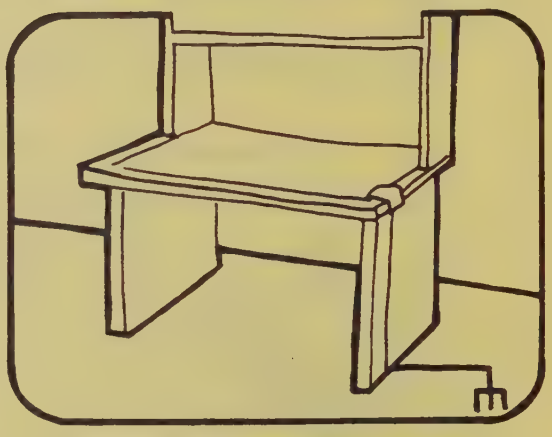
AND GENERAL DYNAMICS, POMONA DIV.



8. WHEN REMOVING PLUG-IN ASSEMBLIES, HANDLE ONLY BY NON-CONDUCTIVE EDGES AND NEVER TOUCH OPEN EDGE CONNECTOR EXCEPT AT STATIC-FREE WORK STATION. PLACING SHORTING STRIPS ON EDGE CONNECTOR HELPS TO PROTECT INSTALLED SS DEVICES.



9. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION
10. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.
11. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

A complete line of static shielding bags and accessories is available from Fluke Parts Department, Telephone 800-526-4731 or write to:

JOHN FLUKE MFG. CO., INC.
PARTS DEPT. M/S 86
9028 EVERGREEN WAY
EVERETT, WA 98204

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Rev. 1 MAR 86

Section 2
Operating Instructions

2-1. INTRODUCTION

2-2. This section contains information regarding installation and operation of the Model 4265A. It is recommended that the contents of this section be thoroughly read and understood before any attempt is made to operate this power source. Should any difficulties be encountered during operation, please contact your nearest John Fluke Sales Representative or the John Fluke Mfg. Co., Inc., P.O. Box 7428, Seattle, Washington 98133, telephone (206) 774-2211. A list of Sales Representatives is located at the rear of this manual.

2-3. SHIPPING INFORMATION

2-4. The Model 4265A was packaged and shipped in a foam packed cardboard carton. Upon receipt, a thorough inspection should be performed to reveal any damage in transient. Special instructions for inspection and claims are included in the carton.

2-5. If reshipment of this power source is necessary, the original container should be used. If the original container is not available, a new one can be obtained from the John Fluke Mfg. Co., Inc. Please reference the Model number when requesting a new shipping container.

2-6. INPUT POWER

2-7. This power source can be operated from either a 115 or 230 vac, 48 to 62 Hz, power line. A decal on the rear panel indicates which power line input is required. If it becomes necessary to change from one power line voltage to the other, proceed as follows:

a. Disconnect the power cord from the rear panel of the power source.

b. Remove the top dust cover and inner cover.

c. Locate the Power Supply Assembly and 115/230 slide switch shown in Figure 2-1.

d. Set the slide switch to the desired line voltage position. Positions are labeled on the printed circuit board.

e. Replace the inner cover and top dust cover.

f. Install the following rated value fuse in the rear panel fuse holder.

115 VAC	230 VAC
2A, AGC	1A, AGC

g. Reconnect the power cord at the rear panel and then energize the power source with the toggle switch on the rear panel. The POWER lamp on the front panel should illuminate.

2-8. RACK INSTALLATION

2-9. The power source is designed for bench-top use or for installation in a 19 inch equipment rack using the Accessory Rack Mounting Kit shown in Figure 2-2. Accessory chassis slides can also be installed to better facilitate rack installation. Information regarding installation of these Ac-

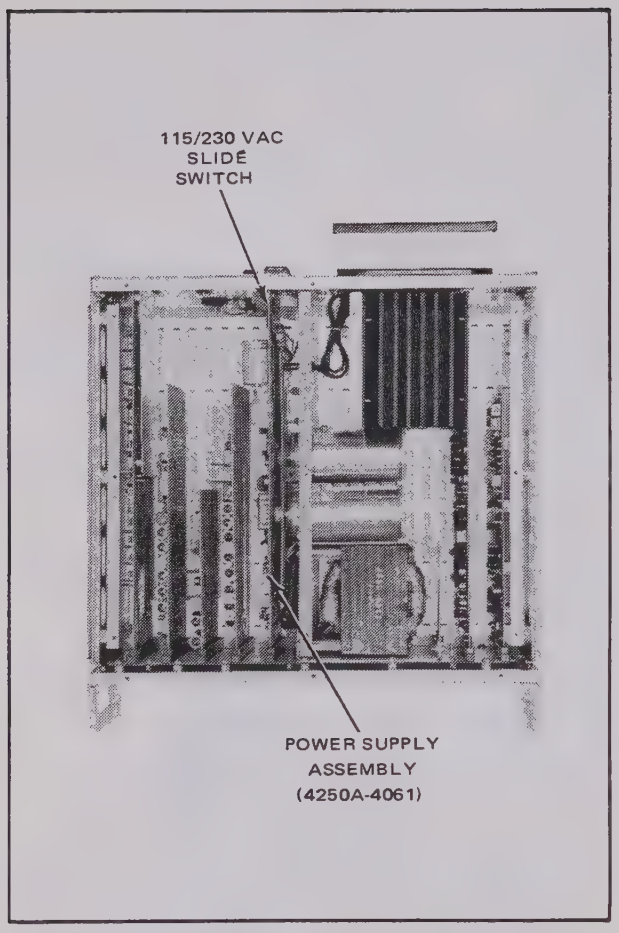


Figure 2-1. 115/230 VAC POWER CONVERSION

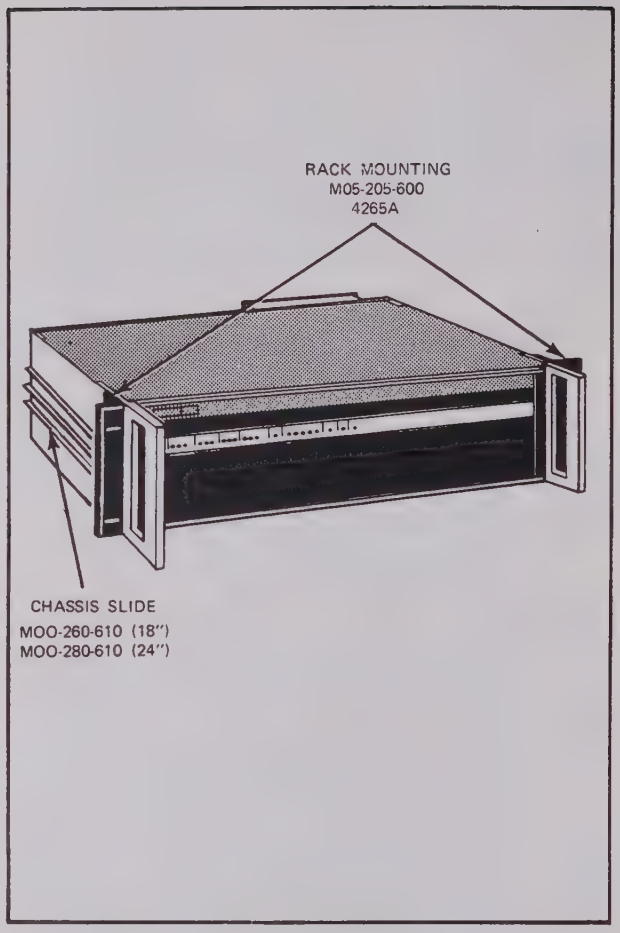


Figure 2-2. ACCESSORY RACK MOUNTING KITS

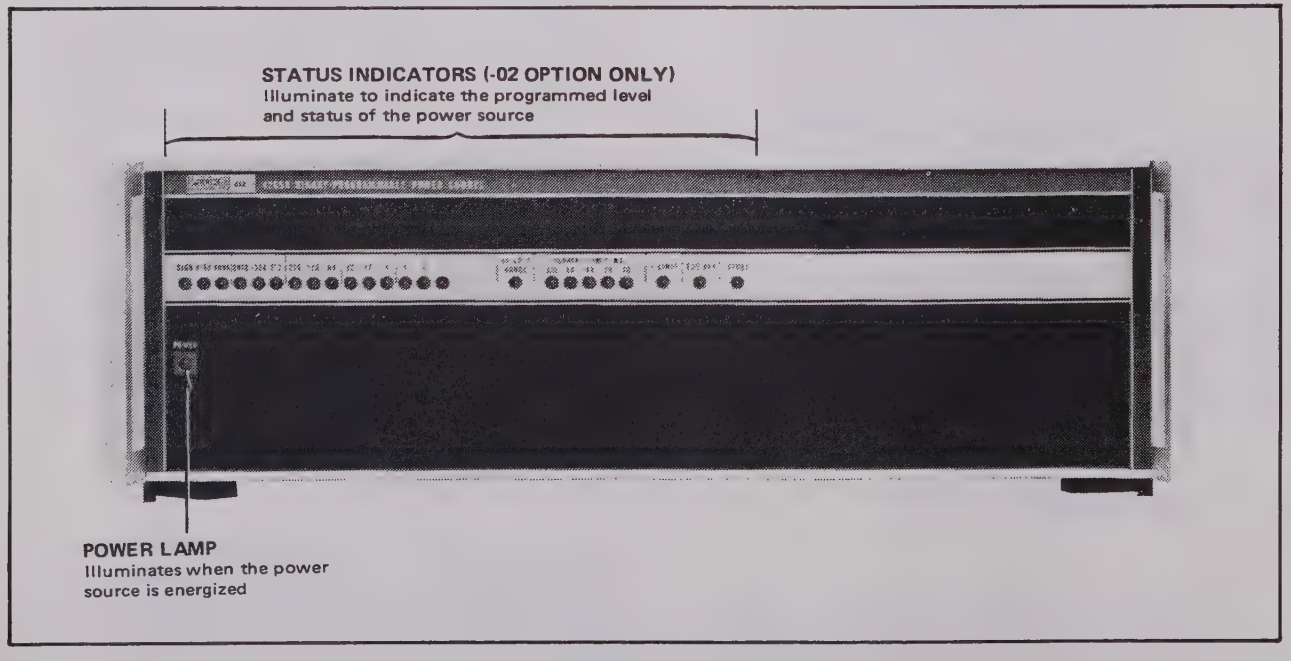

STATUS INDICATORS (-02 OPTION ONLY)
Illuminate to indicate the programmed level
and status of the power source
POWER LAMP
Illuminates when the power
source is energized

Figure 2-3. OPERATING FEATURES (Sheet 1 of 2)

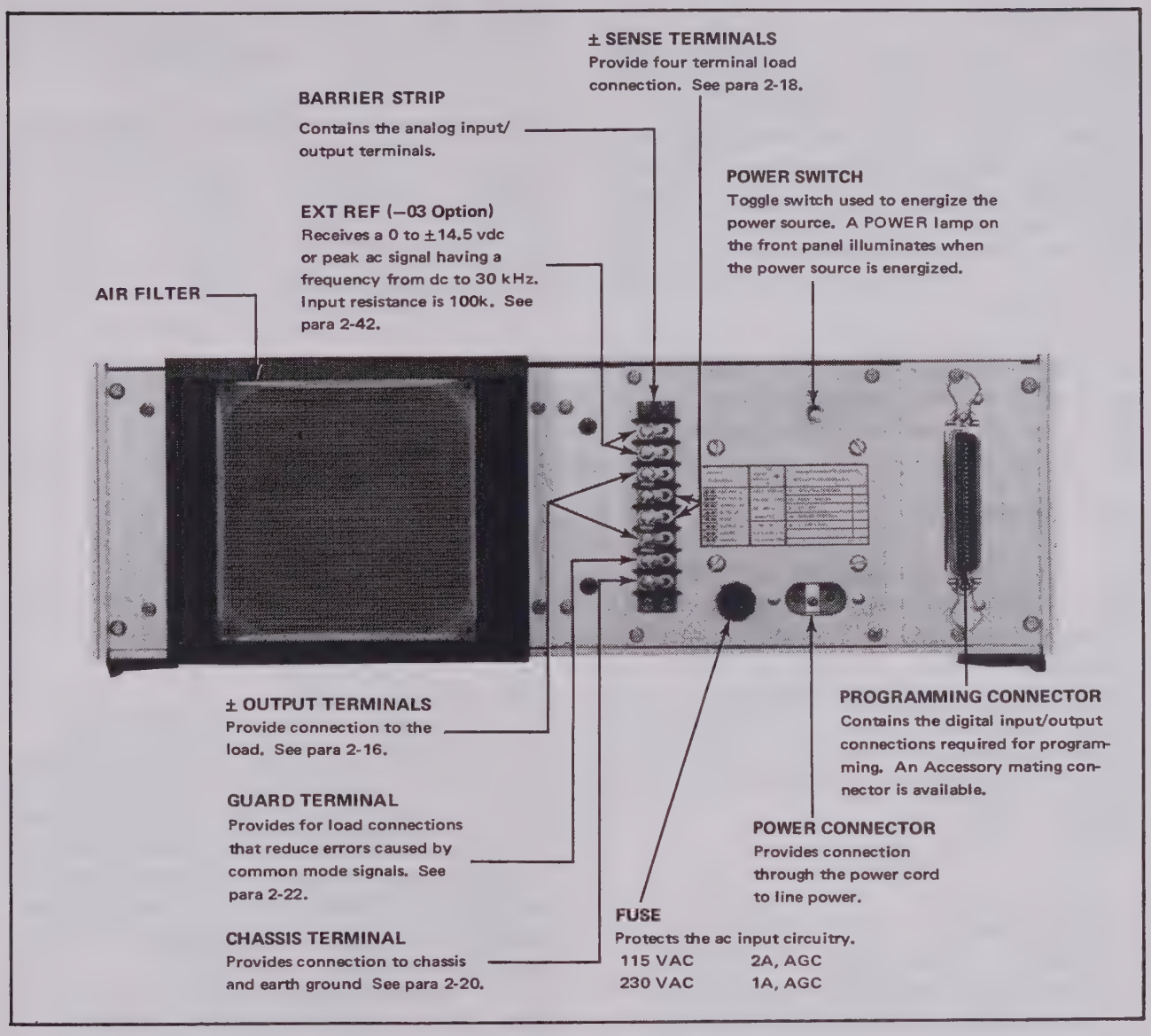

± SENSE TERMINALS
Provide four terminal load connection. See para 2-18.
BARRIER STRIP
Contains the analog input/ output terminals.
POWER SWITCH
Toggle switch used to energize the power source. A POWER lamp on the front panel illuminates when the power source is energized.
EXT REF (–03 Option)
Receives a 0 to ±14.5 vdc or peak ac signal having a frequency from dc to 30 kHz. Input resistance is 100k. See para 2-42.
AIR FILTER
± OUTPUT TERMINALS
Provide connection to the load. See para 2-16.
PROGRAMMING CONNECTOR
Contains the digital input/output connections required for programming. An Accessory mating connector is available.
GUARD TERMINAL
Provides for load connections that reduce errors caused by common mode signals. See para 2-22.
POWER CONNECTOR
Provides connection through the power cord to line power.
FUSE
Protects the ac input circuitry.
115 VAC 2A, AGC
230 VAC 1A, AGC
CHASSIS TERMINAL
Provides connection to chassis and earth ground See para 2-20.

Figure 2-3. OPERATING FEATURES (Sheet 2 of 2)

cessories is given in the Section 6, Rack Installation subsection.

2-10. OPERATING FEATURES

2-11. The location and function of all connectors and indicators is given in Figure 2-3.

2-12. OPERATING NOTES

2-13. The following paragraphs describe various conditions which should be considered before operating the Model 4265A.

2-14. AC Line Connection

2-15. The input power cord plug is a three prong, polarized connection. This plug allows connection to either a 115 or 230 vac, 48 to 62 Hz, power line (see Input Power, paragraph 2-6), while at the same time connects the power source chassis to earth ground. Always ensure that the round pin is connected to a high quality earth ground. The power source is energized through a toggle switch on the rear panel.

2-16. Load Connections

2-17. An eight terminal barrier strip, located on the rear panel, serves as an analog input/output connector for the power source. The ± power output terminals (OUTPUT HI and LO) provide connection to the load. The ± sense ter-

minals (SENSE HI and LO) are provided to allow remote sensing at the load. The sense terminals are bussed through jumpers installed at the factory to the output terminals. If remote sensing is not required, the load is connected to the respective ± output terminals and the sensing busses are not removed. If remote sensing is required, the busses must be removed and separate sense lines provided between the sense terminals and the load. In either case, NEVER operate the power source with the sense terminals disconnected. The CHASSIS terminal is connected directly to the chassis and allows grounding of the load through the input power cord, if desired. The GUARD terminals allows load connections that can greatly reduce errors caused by common mode signals. This guard connection should always be used if optimum noise free performance is to be achieved.

2-18. Remote Sensing

2-19. When a load is connected to the OUTPUT terminals, the I-R drop across the output power leads may be excessive in some applications. If the rated accuracy of the power supply is required at the load, remote sensing must be used. For this reason, SENSE terminals are provided to allow the power supply output to be sensed directly at the load, thus compensating for any I-R drop in the output power leads. Figure 2-4 shows an example of remote sensing load connections.

NOTE!

The two jumpers on the barrier strip which bus ± sense to ± output must be removed for remote sensing. When remote sensing, always use a twisted pair of insulated wire from the output and sense terminals to the load. A maximum of 0.35 volts (at 25°C, decreasing 0.002 volts per degree C at higher temperatures) is allowable between either OUTPUT terminal and its corresponding SENSE terminal. The leads between the OUTPUT and SENSE terminals and the load must be large enough to carry the load current of up to 1 ampere and the sense current of 1 ma without exceeding this voltage.

2-20. Ground Connections

2-21. A CHASSIS terminal is provided at the rear panel. This terminal is directly connected to the chassis of the power source and earth ground through the round pin on the input power plug. If grounding of the load is desired, this terminal provides a convenient connection to earth ground. When a guarded output (explained in paragraph 2-22) is not desired, this terminal should be connected to the GUARD terminal.

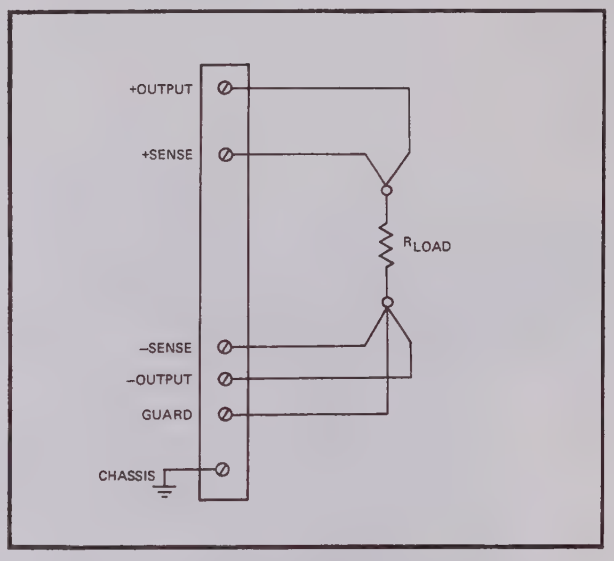


Figure 2-4. REMOTE SENSING CONNECTIONS

2-22. Guard Connections

2-23. The power source is equipped with a guard shield that isolates its internal circuitry from the chassis and ground. A GUARD terminal at the rear panel is connected to this shield and allows load connections that greatly reduce errors caused by common mode signals. The guard may be driven to a maximum of 1000 volts above chassis ground. Figure 2-5 shows a simplified diagram of a guarded load connection.

2-24. PROGRAMMING INFORMATION

2-25. Digital control of all functions except POWER ON is accomplished through a 50 pin Amphenol, Blue Ribbon connector on the rear panel. The power source is energized through a toggle switch on the rear panel. Interface between the programming equipment and the power source requires an Amphenol, Blue Ribbon 57-30500 mating connector. This mating connector is available as an accessory for the power source. It can be obtained from FLUKE under PART NO. 266056. Installation information reguarding this connector is located in Section 6 . Table 2-1 lists and describes each terminal on the Programming Connector.

2-26. Programming input requirements are compatible with either DTL or TTL logic levels. Logic "0" is +2.0 to 5.0 vdc or open circuit to logic ground. Logic "1" is +0.4 vdc or short circuit to logic ground. Logic ground is

Table 2-1. PROGRAMMING INPUT/OUTPUTS

LOGIC "0" = +2 to +5 vdc or open circuit

LOGIC "1" = 0 + 0.4 vdc or short circuit to LOGIC GRD

PIN NO.	FUNCTION		
	CODE = LOGIC "1"	16V RANGE (1 mv steps)	65V RANGE (4 mv steps)
1	8192	8192	32768
2	4096	4096	16384
3	2048	2048	8192
4	1024	1024	4096
5	512	512	2048
6	256	256	1024
7	128	128	512
8	64	64	256
9	32	32	128
10	16	16	64
11	8	8	32
12	4	4	16
13	2	2	8
14	1	1	4
15, 16	NOT USED		
17, 18, 19, 20, 21, 22, 23, 24	LOGIC GRD		
25	LOGIC PWR (+5 vdc current limited by 2.7 ohms)		
26, 27, 28	NOT USED		
29	VOLTAGE RANGE: LOGIC "0" = 16V LOGIC "1" = 65V		
30, 31, 32	NOT USED		

PIN NO.	FUNCTION
33	DATA STROBE (See Figure 2-6 and 2-7) INITIATES DIGITAL TO ANALOG CONVERSION
34	STANDBY/OPERATE: LOGIC "0" = OPERATE LOGIC "1" = STANDBY
35	SIGN: LOGIC "0" = POSITIVE OUTPUT LOGIC "1" = NEGATIVE OUTPUT
36	EXTERNAL REFERENCE (–03 Option): LOGIC "0" = INTERNAL REFERENCE LOGIC "1" = EXTERNAL REFERENCE
37	READY/NOT READY FLAG: LOGIC "0" = READY LOGIC "1" = NOT READY
38, 39, 40, 41	NOT USED
42	CURRENT LIMIT RANGE (–06 Option): LOGIC "0" = 100 MA LOGIC "1" = 1 AMP
43	LOGIC "1" = 80%
44	LOGIC "1" = 40%
45	LOGIC "1" = 20%
46	LOGIC "1" = 10% CURRENT LIMIT % RANGE (–06 Option) *NOTE: All "0"'s = 10% of Range*
47, 48	NOT USED
49	CURRENT LIMIT FLAG: LOGIC "0" = NORMAL LOGIC "1" = OVERLOAD
50	NOT USED

Table 2-2. BINARY AND TWO'S COMPLEMENT CODING (16V RANGE)

OUTPUT VOLTAGE	BINARY		OUTPUT VOLTAGE	TWO'S COMPLEMENT	
	Sign	Code		Sign	Code
Ov	0	00000000000000	Ov	1	00000000000000 (not valid)
+1 mv	0	00000000000001	–1 mv	1	11111111111111
+8.192	0	10000000000000	–8.192	1	10000000000000
+16.383	0	11111111111111	–16.383	1	00000000000001

available at pins 17 through 24 of the programming connector. Shorting these lines to the appropriate pins of the programming connector using contact closures also allows control of the power source. The internal +5 vdc output, current limited by 2.7 ohms, is available at pin 25 for use by the external programming logic.

2-27. Standby

2-28. The STANDBY mode can be programmed by applying a Logic "1" to pin 34 of the Programming Connector. When this condition exists, the output voltage of the power source will be less than 1% of the programmed value. Application of a Logic "0" at this pin returns the output voltage to the programmed level.

2-29. Range/Output Magnitude/Polarity

2-30. Two voltage ranges are available; ±16 volts and ±65 volts. The RANGE is programmed by a single line input at pin 29 of the Programming Connector. A Logic "0" applied to this pin will program the ±16 volt range, and a Logic "1" will program the ±65 volt range. The power supply is capable of an output of ±66v minimum at 1 ampere.

2-31. The magnitude of the output voltage is programmed with binary coded inputs at pins 1 through 14 of the Programming Connector. When the 16 volt range is called, resolution is in 1 mv steps. In the 65 volt range, resolution is in 4 mv steps and the programmed output voltage is four times that of the binary input. Upon installation of a jumper in the Preamplifier (4265A-4051), the bit weight can be changed to give a MSB of 8.000v in the 16 volt range and 32.000v in the 65 volt range.

2-32. Polarity of the output is controlled by a single binary input (SIGN) at pin 35 of the Programming Connector. A Logic "0" will produce a positive output, and Logic "1" will produce a negative output. When the Isolated Control Logic (–01 Option) is installed, Two's complement coding is required for negative outputs. Table 2-2 shows a comparison between binary and Two's complement coding.

2-33. Data Strobe

2-34. The DATA STROBE shown in Figure 2-6 is required to initiate the transfer of the data present at the programming inputs to the internal memory of the Isolated Control Logic (–01 Option). The DATA STROBE is applied to pin 33 of the Programming Connector. Upon its negative

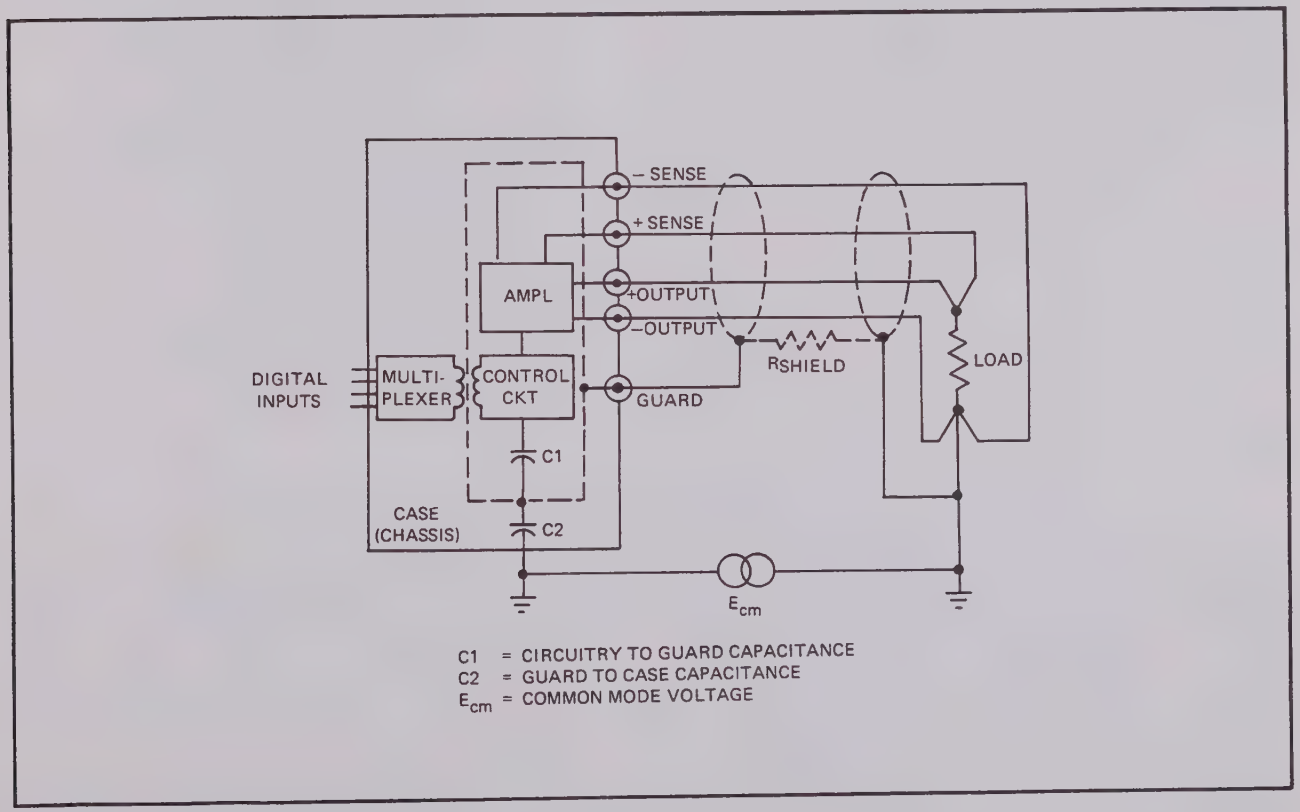


Figure 2-5. GUARDED LOAD CONNECTION

transition, program data transfer begins. At the same time, two pulses are generated; 15 μsec and 100 μsec. The 15 μsec pulse holds the power supply output at its previously programmed level while new data is transferred into memory and allowed to settle. At the end of the 15 μsec pulse the power source is allowed to respond to the new program data. The 100 μsec pulse provides a READY/NOT READY output that indicates the power source has had time to respond to new program data and the output to be within ±0.01% of the programmed change for a resistive load. Program data must be present and settled for a minimum of 2.4 μsec after the negative transition of the DATA STROBE.

NOTE!

When the power supply is initially turned on or if a power interruption occurs, the power supply is programmed to zero volts, where it will remain until new data is transferred.

2-35. When the Direct Coupled Logic (–04 Option) is installed, the DATA STROBE shown in Figure 2-7 is used to hold the output voltage constant while programming data is changed. However, the period of the DATA STROBE must match the program change interval. If this is not done, the output will follow any program changes, which is normal for direct programming. The 100 μsec READY/NOT READY FLAG begins at the end of positive transition of the DATA STROBE and serves to indicate the source has had time to respond to new program data and be within ±0.01% of the programmed change for a resistive load.

2-36. Flag Outputs

2-37. Two flag outputs are provided to indicate when a current overload exists, and when the output voltage has had time to settle. A current OVERLOAD is indicated by a Logic "1" at pin 49 of the Programming Connector. Normal operation is indicated by a Logic "0". Output settling time is indicated by a READY/NOT READY FLAG at pin 37. Logic "0" is the READY condition and indicates that the output voltage has had time to settle to within 0.01% of the programmed change for a resistive load. A Logic "1" indicates a NOT READY condition.

2-38. The OVERLOAD FLAG and the NOT READY FLAG will both be activated when a sink or source current overload occurs. After the overload is removed, the OVERLOAD FLAG will return to normal but the NOT READY FLAG will remain for 100 μsec to allow for output settling time. Figure 2-6 and 2-7 show the timing relations of these flags. If the Programmable Current Limiting (–06 Option) is installed, the OVERLOAD FLAG will also be activated when current limiting occurs.

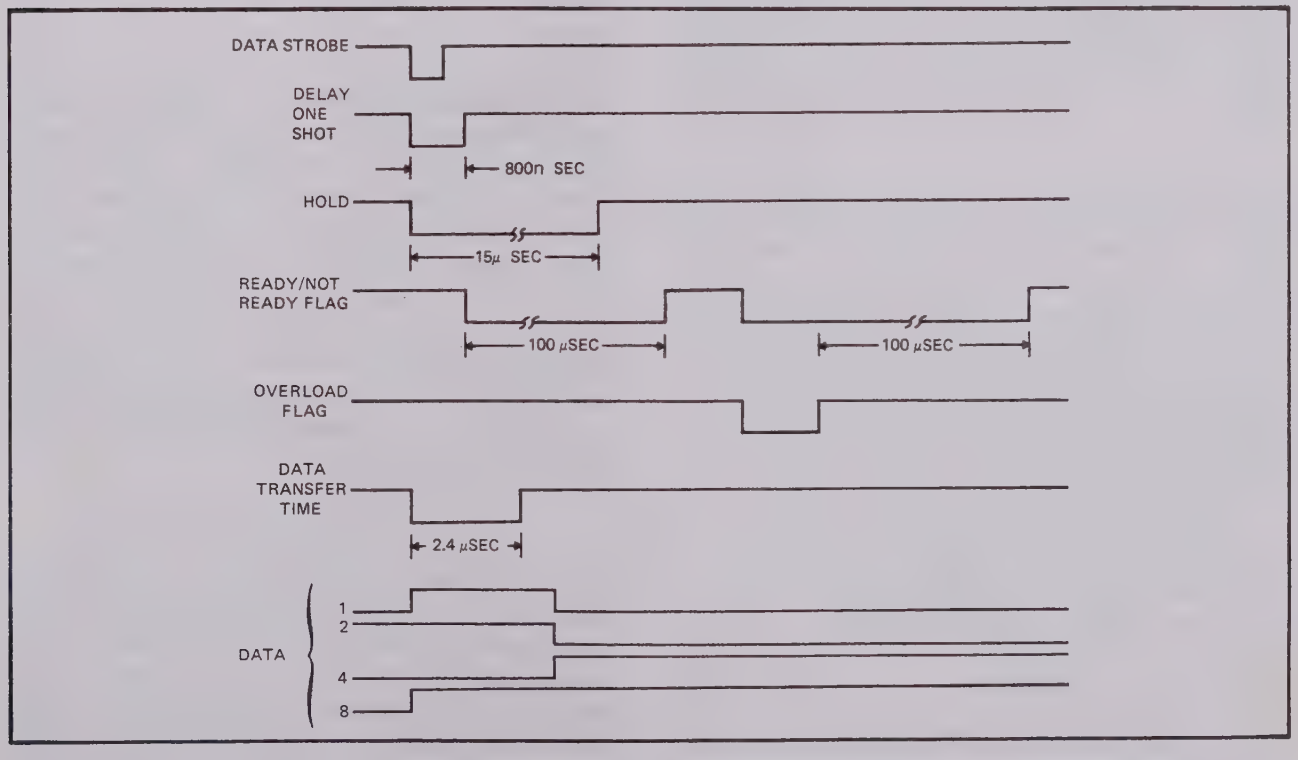


Figure 2-6. ISOLATED CONTROL LOGIC TIMING (–01 OPTION)

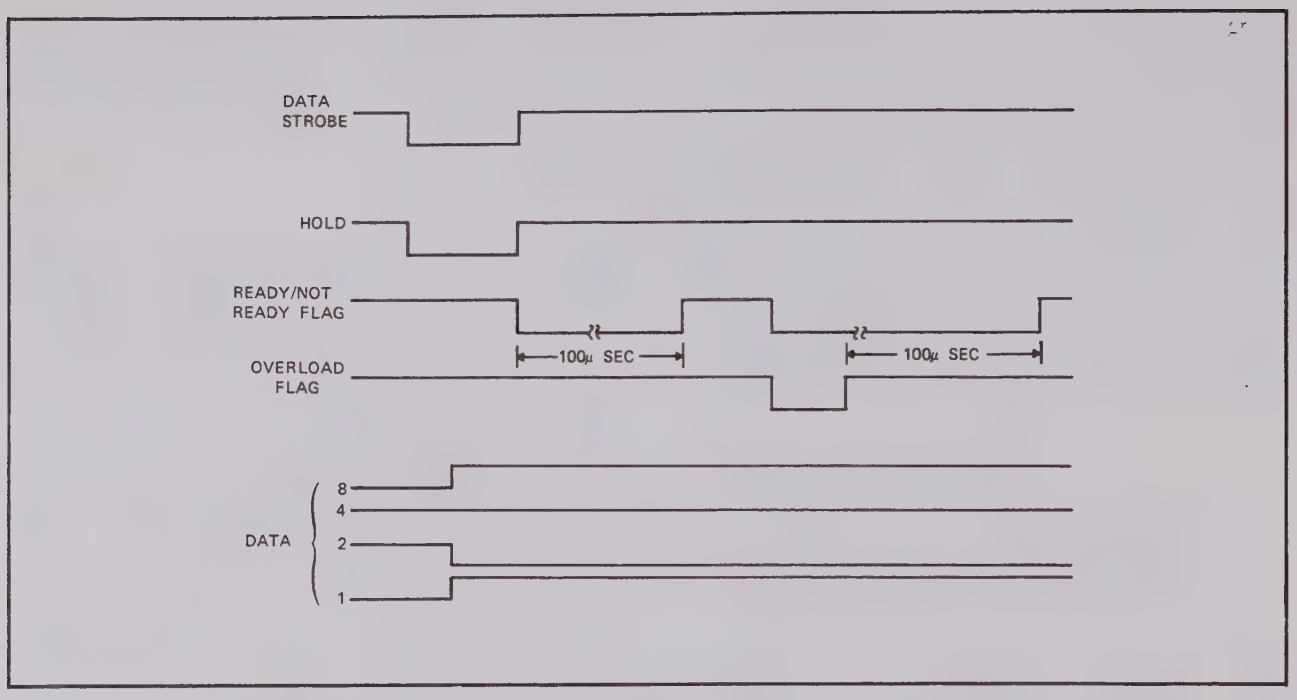


Figure 2-7. DIRECT CONTROL LOGIC TIMING (–04 OPTION)

2-39. Programmable Current Limiting

2-40. When the Programmable Current Limiter (–06 Option) is installed, two ranges of current limiting are available; ±1.0 amp and ±100 ma. The CURRENT RANGE is programmed by a single binary input at pin 42 of the Programming Connector. A Logic "0" applied to this pin programs the 100 ma range and a Logic "1" programs the 1.0 amp range.

2-41. The magnitude of the output current is programmed by applying binary coding to pins 43 through 46 of the Programming Connector. Current magnitude programming is in increments of 10% of the programmed range. If all current magnitude inputs are programmed to Logic "0", the current limit is still 10% of the programmed range. The maximum current limit that can be programmed is 110% of the programmed range. When current limiting occurs, the OVERLOAD FLAG changes from Logic "0" to Logic "1" as described in paragraph 2-38.

NOTE!

A sink capability greater than the programmed current limit value cannot be realized.

2-42. External Reference

2-43. When the External Reference (–03 Option) is installed, a single programming bit is used to remove the internal 10 vdc reference from the D-to-A ladder network and switch in an external signal source to replace it. The output accuracy and stability of the power source, however, is then relative to the accuracy and stability of the external signal source.

2-44. The external reference may be any dc or ac signal with an amplitude between 0 and ±14.5 vdc or peak ac (volts rms x 1.414) and have a frequency between dc and 30 kHz. It is applied to the ± EXT REF terminals located on the rear panel barrier strip. The input impedance at these terminals is 100k ohms in parallel with 70 pf. The EXT REF is programmed by applying a Logic "1" to pin 36 of the Programming Connector. It should be noted that the polarity of the output will be the same as the EXT REF regardless of the SIGN (polarity) program. For this reason, only a positive binary magnitude code should be used when the EXT REF is an ac signal.

2-45. Programming the magnitude of the output voltage with a ±10 volt EXT REF is accomplished by the same method used for programming with the internal reference voltage. (See paragraph 2-31.) However, if the EXT REF is not exactly ±10 volts, the magnitude of the programming word required to obtain a specified output voltage must be calculated as follows:

MPW = Magnitude of the programming word.

E_{OUT} = Output (vdc)

EXT REF = External Reference voltage (vdc or peak ac)

16 volt range: $E_{OUT} = (MPW \times 10^{-4})(EXT\ REF)$ therefore:

$$MPW = \frac{E_{OUT}}{EXT\ REF} \times 10^4$$

Programming resolution = EXT REF x 10^{-4}

---

65 Volt range: $E_{OUT} = (4\ MPW \times 10^{-4})(EXT\ REF)$ therefore:

$$MPW = \frac{E_{OUT}}{4\ (EXT\ REF)} \times 10^4$$

Programming resolution = 4 (EXT REF) x 10^{-4}

NOTE: $E_{OUT} \leqslant 66$

It should be noted that the rated output of the power supply is ±66v minimum at 1 ampere. Higher voltage output is obtainable depending on line voltage and output current, i.e. ±85v typical at 115 vac line and no load. It therefore becomes obvious that when using the 65 volt range, the programming word can easily exceed the output capability of the power source. The following example, using previously shown formula for the 65 volt range, will clearly illustrate this.

Example:

Find: E_{OUT}

Given: EXT REF = +14.5 vdc, MPW = 16.383, Range = 65 volt

$E_{OUT} = (4\ MPW \times 10^{-4})(EXT\ REF)$
$(4 \times 16.383 \times 10^{-4})(14.5)$
$(6.5532)(14.5)$

E_{OUT} = 95.0214 vdc

E_{OUT} in this example greatly exceeds the 66 volt output capability of the power supply. To avoid this situation always calculate MPW with E_{OUT} VO $\leqslant$ 66.

2-46. Front Panel Indicators

2-47. When the Front Panel Display (–02 Option) is installed, status lamps (light emitting diodes) are provided on the front panel. These lamps indicate the programmed output voltage level, output polarity, current overload, current limit level, external reference, and standby status of the internal register. None of these lamps are provided when the BLANK FRONT PANEL (–05 Option) is installed. A POWER lamp is included with either option to indicate that the power source is energized.

2-48. Dynamic Characteristics

2-49. The power source output can be changed quite rapidly with high speed programming information. However, a 100 μsec period must be allowed before the output has settled to its stated accuracy for a resistive load.

2-50. When an external signal is used as the reference for the power source, the output accuracy is dependent upon the characterisitics of the external signal. If a dc voltage is used, the output accuracy is related to the accuracy and stability of the external voltage. However, if an ac signal is used, the output accuracy is not only dependent upon the external signal stability, but also its frequency. Typical examples of accuracy versus frequency are shown in Figures 2-8 through 2-11.

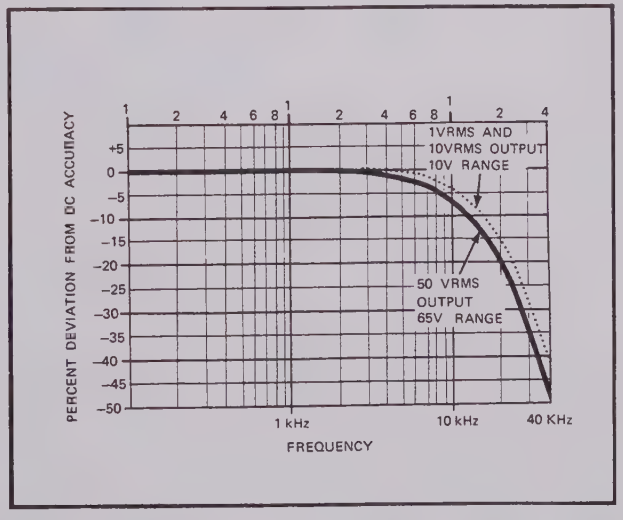


Figure 2-8. ACCURACY VERSUS EXTERNAL REFERENCE FREQUENCY

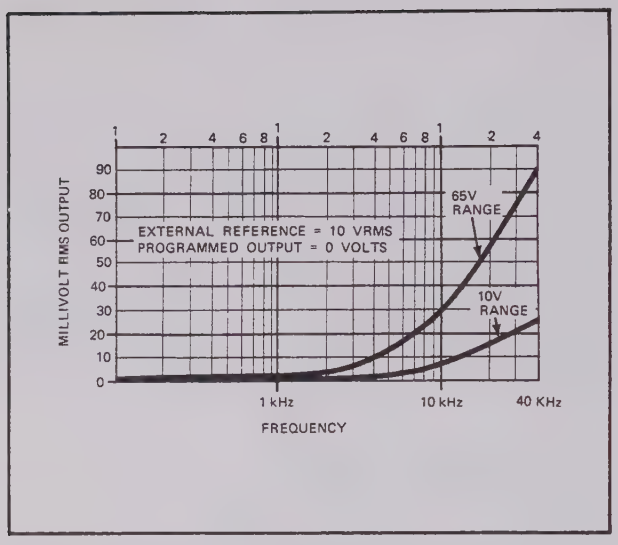


Figure 2-9. AC EXTERNAL REFERENCE FEED-THROUGH VERSUS FREQUENCY (OV OUTPUT)

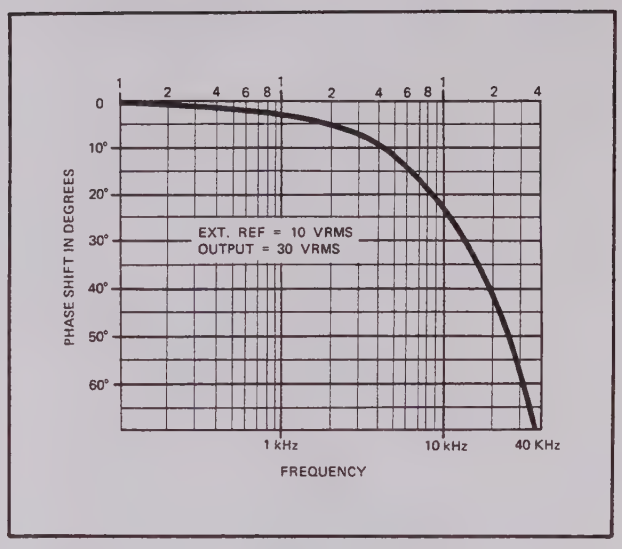


Figure 2-10. AC EXTERNAL REFERENCE PHASE SHIFT VERSUS FREQUENCY

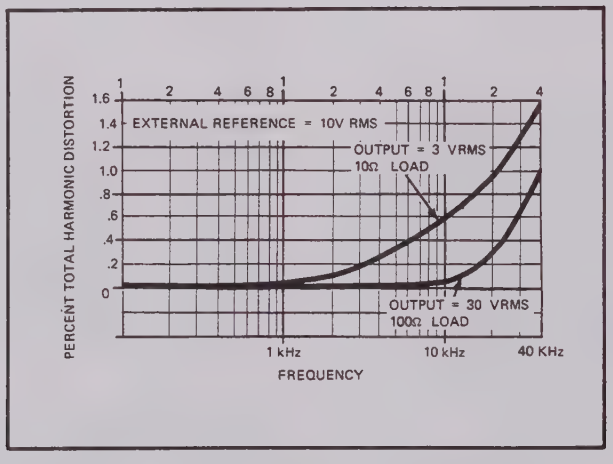


Figure 2-11. AC EXTERNAL REFERENCE HARMONIC DISTORTION VERSUS FREQUENCY

Section 3

Theory of Operation

3-1. INTRODUCTION

3-2. This section contains the theory of operation for the Model 4265A. The information is arranged under headings of "FUNDAMENTAL CIRCUIT DESCRIPTIONS, BLOCK DIAGRAM ANALYSIS, and CIRCUIT DESCRIPTIONS." An equivalent circuit of the power source is shown in Figure 3-1. Figure 3-2 is a simplified block diagram that includes all options.

3-3. FUNDAMENTAL CIRCUIT DESCRIPTION

3-4. The Model 4265A converts a digital program word into a representative dc output voltage. Basically, the circuitry consists of a high gain operational amplifier shown in Figure 3-1. Digital to analog conversion is done using a ladder network driven by a bi-polar reference voltage. The differential amplifier then produces an output voltage (Vo) that is maintained by the current through R_f as determined by the ratio of V_{REF} over R_o $\left(\frac{V_{REF}}{R_o}\right)$.

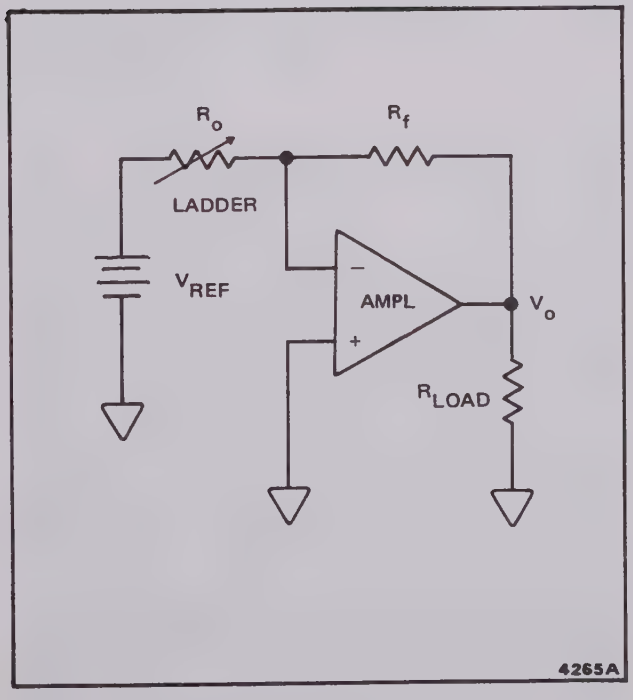


Figure 3-1. POWER SOURCE EQUIVALENT CIRCUIT

3-5. BLOCK DIAGRAM ANALYSIS

3-6. The following paragraphs describe the major circuit functions of the Model 4265A. A block diagram of the power source, including all options, is shown in Figure 3-2.

3-7. One of two A6 Logic assemblies receive and process the digital inputs. The Isolated Control Logic (–01 Option) provides isolation and storage of the digital inputs. A STROBE input is required for any data transfer. The Direct Coupled Control Logic (–04 Option) provides only level shifting of the inputs. Both assemblies provide READY/NOT READY and CURRENT LIMIT FLAG outputs. Internal commands from the A6 LOGIC control polarity, range, magnitude, sample and hold, and current limiting of the output. These commands (except sample and hold) are also applied to the A7 Display where, if the –02 Option is installed, visual status is provided on the front panel.

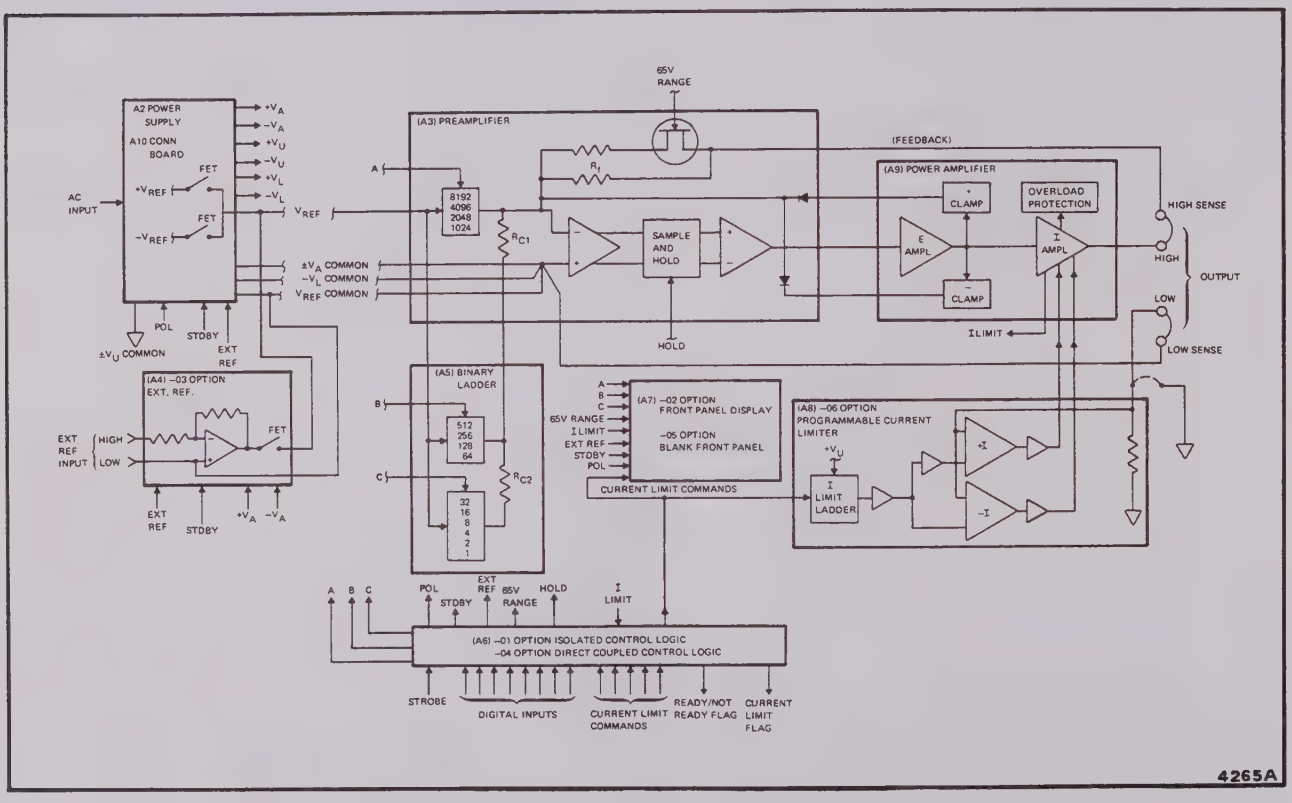


Figure 3-2. MODEL 4265A BLOCK DIAGRAM

3-8. All operating voltages as well as the internal reference voltage (V_{REF}) are produced in the A2 Power Supply and the A10 Connector Board. Commands from the A6 Logic determine the polarity of V_{REF} applied to V_{REF} bus line. A +POL command produces a $-V_{REF}$ and a –POL command a $+V_{REF}$. Presence of either or both EXT REF and STDBY commands disables the internal V_{REF}.

3-9. The A4 External Reference (–03 Option) processes the external reference input voltage. The magnitude of this voltage can be from 0 to ±14.5V dc or peak ac and have a frequency from dc to 30 kHz. Presence of an EXT REF command disables the previously described internal V_{REF} and applies the output of the A4 External Reference to the V_{REF} bus line. If a STDBY command exists, the external V_{REF} is disabled.

3-10. Binary ladder networks in the A3 Preamplifier and A5 Binary Ladder scale the selected internal or external V_{REF} to a level determined by the A, B, and C commands. This scaled voltage is then inverted and amplified by voltage and power amplifiers in the A3 Preamplifier and A9 Power Amplifier. Current through R_f in the A3 Preamplifier maintains a proportional output voltage dependent upon the value of R_f, ladder, and polarity of V_{REF}. In the 16V range, the total parallel value of R_f in combination with an internal V_{REF} estab-

lishes an output in millivolts directly proportional to the digital input word. The value of R_f is increased by four times in the 65V range by disconnection of one of the R_f resistors. Subsequently, outputs in the 65V range are four times the digital input word. When the external V_{REF} is selected, the output is proportional to the combined effects of the external reference magnitude and the digital input word. Actual output is determined as follows:

16V Range: Eout = MPW x 10^{-4}) (EXT REF)
65V Range: Eout = (4MPW x 10^{-4}) (EXT REF)
Where: MPW = Magnitude of digital input word
EXT REF = External reference voltage. (V dc or peak ac):

3-11. Programming changes are prevented from appearing at the output until the entire digital input word is stored. This is provided through the sample and hold circuit in the A3 Preamplifier. Presence of a STROBE input to the A6 Logic produces a HOLD command which activates the sample and hold circuit. The sample and hold disconnects and stores the last input to the voltage amplifier, thus providing a memory condition for the duration of the HOLD command. The HOLD command has a duration of 15 μsec when the A6 Isolated Control Logic (−01 Option) is installed. Duration of the HOLD command is proportional to the STROBE input when the A6 Direct Coupled Control Logic (−04 Option) is installed.

3-12. Overload protection circuitry in the A9 Power Amplifier automatically limits the maximum output current to 1.2A. Whenever a current limit occurs, an I LIMIT command is applied to the A6 Logic which then produces a CURRENT LIMIT FLAG output. Current limiting at less than 1.2A is also possible using the A8 Programmable Current Limiter (−06 Option) described later. Clamp circuits in the A9 Power Amplifier limit voltage transients at the output during a current limit condition when the load is disconnected.

3-13. Current limiting at less than 1.2A is provided upon installation of the A8 Programmable Current Limiter (−06 Option). Maximum bipolar output current can be limited to a level between 10 ma and 1.1 ampere in 10 percent steps on two separate ranges. In the event the output current is clamped at that level by action of the A8 Programmable Current Limiter. During periods of current limiting, an I LIMIT command is generated in the A9 Power Amplifier and is applied to the A6 Control Logic and to the A7 Front Panel. The I LIMIT command applied to the A6 Control Logic produces a CURRENT LIMIT FLAG at pin 49 of the Programming Connector. The I LIMIT command applied to the A7 Front Panel illuminates the I LIMIT indicator on the front panel if the −02 Option is installed.

3-14. CIRCUIT DESCRIPTIONS

3-15. The following paragraphs describe the circuitry in the power source. Each description is keyed to a schematic diagram located at the rear of the manual.

3-16. A2 Power Supply and A10 Connector Board (Schematic No. 4250A-1061 and 4250A-1012)

3-17. All operating voltages, as well as the internal reference voltage upon which the power source accuracy and stability relies, are produced in the A2 and A10 assemblies. Designations and nominal magnitudes of each voltage is given in Table 3-1.

Table 3-1. OPERATING VOLTAGES

DESIGNATION	VOLTAGE (VDC)
$+V_L$	+5V
$-V_L$	−5V
$\pm V_U$	±104V [1]
$\pm V_A$	+23.4V, −25.1V
V_{REF}	±10V

[1] Approximate (at 115V line voltage, no load)

3-18. INPUT POWER. AC line power at J1 is applied to the primary of T1 through POWER switch S2 and the 115/230 switch S1. The primary of T1 consists of two windings which allow operation from either a 115 or 230V ac line. S1 provides a parallel primary winding connection for 115V ac line operation. A series connection is provided for 230V ac line operation. AC power for the blower M1 is provided from one of the primary windings of T1. The four secondary windings of T1 supply ac voltages to associated power supplies.

3-19. $+V_L$ SUPPLY. The $+V_L$ Supply, composed of CR19 and Q21 through Q24, produces a regulated +5V dc for use by the A6 Logic and external programming equipment. Diode bridge CR19 rectifies the secondary voltage of T1 and supplies the series regulator of Q21 through Q24 with a dc voltage. C16 filters the voltage applied to the regulator. Q22 functions as a constant current source, supplying base drive to Q23. The resulting +5V output

of the regulator is developed across CR23 and R54 which supplies a sample of the output voltage to the base of Q24. The conduction of Q24 will limit the base drive to Q21 and Q23 producing a regulated +5V output. This supply is completely isolated from all other supplies in the instrument and is electrically external of the guard. All other supplies are electrically inside the guard.

3-20. $-V_L$ SUPPLY. The $-V_L$ Supply composed of CR14 and Q16 through Q18 produces the regulated −5V dc required to operate the internal logic circuits. Diode bridge CR14 rectifies the secondary voltage of T1 and supplies the series regulator of Q16 through Q18 with a dc voltage. C13 filters the rectified voltage. The base drive for Q18 and Q17 is derived from the $+V_A$ Supply through R44. Reference voltage for the base of Q18 is derived from the $-V_A$ Supply through the divider consisting of R46 and R47. Any variation in the −5V output is then sensed by Q18, which controls the base drive to A17 and thus Q16, producing a regulated −5V dc output.

3-21. $\pm V_A$ SUPPLY. The $\pm V_A$ Supply produces the regulated +23.4 and −25.1V dc operating voltages that are used to provide power for most analog circuitry. Diode bridge CR4 rectifies the tapped secondary voltage of T1 and supplies positive and negative voltages for the respective $\pm V_A$ regulators. C7 and C8 filter these rectified voltages.

3-22. The $+V_A$ regulator consists of Q12, Q13 and A4. Reference voltage for this regulator is derived from A2 in the V_{REF} supply and is applied to the non-inverting input of A4. The inverting input of A4 receives a sample of the output voltage from the divider, R36 and R37. Any variations in the $+V_A$ output are thus sensed by A4, which controls the base drive to Q12, producing a regulated +23.4V dc output. Q13 together with R33 function to limit the maximum output current of this supply to 125 ma. Should the current through R33 exceed 125 ma, the voltage across R33 will turn on Q13 whick limits the base current to Q12.

3-23. The $-V_A$ regulator consists of Q14, Q15, and A5. R40 and the $+V_A$ supply establish the reference current for the feedback resistor R41. A5 supplies the base drive required by Q15 to maintain the regulated output of −25.1V dc. Q14 and R39 limit the output current in a similiar manner to Q13 and R33 described previously.

3-24. $\pm V_U$ SUPPLY. The $\pm V_U$ Supply produces unregulated ±104V dc operating voltage for the A9 Power Amplifier. Diodes CR1 through CR4 are connected as two full-wave rectifiers to produce $\pm V_U$ operating voltages from the secondary of T1. C1 and C2 filter the resulting outputs. R1 and R2 function as discharge resistors for C1 and C2, respectively.

3-25. V_{REF} SUPPLY. The V_{REF} Supply produces an extremely stable ±10V dc reference upon which the accuracy and stability of the power source is based. Circuitry of this supply consists of a stable reference amplifier A2, a differential amplifier A1, a series-pass element Q1, an inverter amplifier A3, and an emitter follower Q4.

3-26. The reference amplifier A2 contains matched zener and transistor elements which produce a time and temperature stabilized reference voltage. The zener element receives a portion of its bias current from the +23.4V supply through R4 and CR1. The amplifier element receives collector current from the same source through R5. Base current for this amplifier is provided through a divider composed of R9, R14, R16, R56 and R59. This divider is connected to the $+V_{REF}$ sense line. The FET switches, Q2 and Q3, provide separate output and sense connections when a positive V_{REF} is called. Should any variations occur on the $+V_{REF}$ sense line, A2 will amplify them with respect to the zener element reference. The change is then applied to one input of A1 which also receives a sample of the $+V_{REF}$ line from the divider composed of R2 and R3. A1 in turn amplifies the change and alters the conduction of Q1 to maintain a constant +10V output for $+V_{REF}$ sense. Variable resistor R9 allows adjustment of the sense line input to A2 and subsequently the $+V_{REF}$ sense level.

3-27. The inverter amplifier composed of A3 and Q4 produces a $-V_{REF}$. A3 is connected as an inverting, unity gain, amplifier. Emitter follower Q4 functions as an output buffer. Feedback through R19 and R18 controls the overall gain of both amplifiers. Variable resistor R19 adjusts this feedback level and subsequently the resultant $-V_{REF}$ sense output level. Resistors R6 and R21 compensate for TC factors associated with FET gates in the ladder section driven by V_{REF}.

3-28. GATE DRIVERS. The Gate Drivers of Q7 through Q11 control the conduction of the FET switches associated with the V_{REF} Supply. When the power source has a positive output programmed, the command at pin 18 is low (−5V), thus turning on Q8, Q11 and switching off FET gates Q2, Q3. With Q8 on, the emitter-base junction of Q9 is reverse biased causing Q9 and Q10 to turn off, thus turning on FET gates Q5, Q6, and Q25. The V_{REF} output applied to pin D is therefore −10V when a positive output

is programmed. Should a negative output be programmed, the command at pin 18 is high (0V), which turns off Q8 and Q11 and switches the FET gates Q2 and Q3 on. With Q8 cut-off, Q9 conducts and turns on Q10, thus switching the FET gates Q5, Q6, and Q25 off. As a result, the voltage at pin D is +10V when a negative output is called. Should the STANDBY or EXT REF mode be programmed, low (−5V) commands exist at pins S or V. These low inputs will turn on Q7 and Q8, thus turning on both Q10 and Q11 and switch all FET gates off. As a result the V_{REF} supply is completely disconnected from the V_{REF} output terminals, B and D.

3-29. RELAY DRIVER. The Relay Driver composed of Q19 and Q20 is used to energize K1 when the power source is turned on. The contacts of K1 then complete the connections to the OUTPUT connector. Should the power source be shut off for any reason, the connections are broken and the load is not subjected to any unprogrammed voltage.

3-30. A4 External Reference (4210A-1041)

3-31. The A4 External Reference is installed as the −03 Option. It receives and processes an external reference input having a frequency of dc to 30 kHz and a level from 0 to ±14.5V dc or peak ac. The circuitry consists of three differential amplifiers and an emitter follower which form an operational amplifier. FET gates Q9 and Q10 controlled by drivers Q11 and Q12 apply the amplifier output and sense line to the V_{REF} line in the A3 Preamplifier.

3-32. DIFFERENTIAL AMPLIFIER. The Differential Amplifier consists of three individual amplifiers: Q1 through Q8 and the emitter follower Q13. The external reference input is applied through R1 and C9 to one input of the differential FET, Q1. This stage amplifies the input in respect to V_{REF} common and provides a differential input to Q5. Feedback through R16 and R17 maintains the input of Q1 at virtual V_{REF} common. Adjustment of R17 controls the overall gain and subsequently the output V_{REF} high at terminal 4. Variable resistor R6 allows zero offset adjustment of the output, V_{REF} high. Jumper selection of R5 and R8 through R10 provides coarse adjustment of offset. Selection of R_N and R_P in the drain circuit of Q1 is done to provide a low temperature coefficient for the offset voltage. A constant current source for Q1 is provided by Q2, while TC compensation of the current source is provided by Q3. The differential Darlington composed of Q4 and Q5 amplifies the output of Q1 and furnishes a single-ended drive signal to Q7. This drive signal is developed across Q6 which functions as a high impedance, constant current source for Q4B. The final quasi-differential amplifier Q7 and Q8 supplies a drive signal to the emitter-follower output stage of Q13. This stage provides a low impedance output to drive the V_{REF} high line. Q14 functions as a high impedance current source for Q13. Diodes CR1 and CR2 provide connection to the feedback line when Q9 and Q10 are turned off.

3-33. FET GATES. Q9 and Q10 control application of the external reference to the internal V_{REF} lines. Q9 connects the feedback line to V_{REF} SENSE, and Q10 connects the external reference to the internal V_{REF} HIGH line. Drivers Q11 and Q12 control the on/off condition of Q9 and Q10 in conjunction with the EXT REF and STANDBY commands at terminals 13 and M.

3-34. When an EXT REF command (0V) exists at terminal 13, Q11 is turned off, and $-V_A$ is applied to both the emitter and base of Q12. This condition turns off Q12 and switches FET gates Q9 and Q10 on, thus applying the external reference to the internal V_{REF} line. The same condition occurs when a STANDBY command (0V) exists at terminal M. Diodes CR3 and CR4 provide isolation between the input command lines.

3-35. Should a STANDBY or EXT REF command (−5V) exist, Q11 will be switched on and turn on Q12. Conduction of Q12 applies $-V_A$ to the gates of Q9 and Q10 which turns them off. This condition then disconnects the external reference from the internal V_{REF} lines.

3-36. A5 Binary Ladder (4216-1031)

3-37. The A5 Binary Ladder contains the lower ten segments of a 14-bit binary ladder and its associated drivers. The $V_{R'}$ Supply, which is a unity gain buffer, is also located on this assembly. It is used to prevent loading of V_{REF} by the ladder drivers. The ladder is a binary weighted voltage divider controlled by the digital program word. The resistance and the relative position of each ladder segment, with respect to the output, determines the significance of its contribution to the total output voltage.

3-38. $V_{R'}$ SUPPLY. The $V_{R'}$ Supply composed of Q1 through Q3 is a unity gain buffer amplifier. Q3 is the buffer stage for emitter follower Q2. Diode CR1 compensates for the input offset voltage at emitter-base junction of Q2. The currents through Q2 and CR1 are held constant by the current regulator Q1. This allows the $V_{R'}$ output to closely track V_{REF} over a wide voltage range.

3-39. LADDERS. The ten lower segments of the binary ladder consist of R1 through R3, and R5 through R15. Each segment of the ladder is formed essentially by a resistor whose value is inversely proportional to its binary weight. A simplified diagram of a typical binary ladder is shown in Figure 3-3.

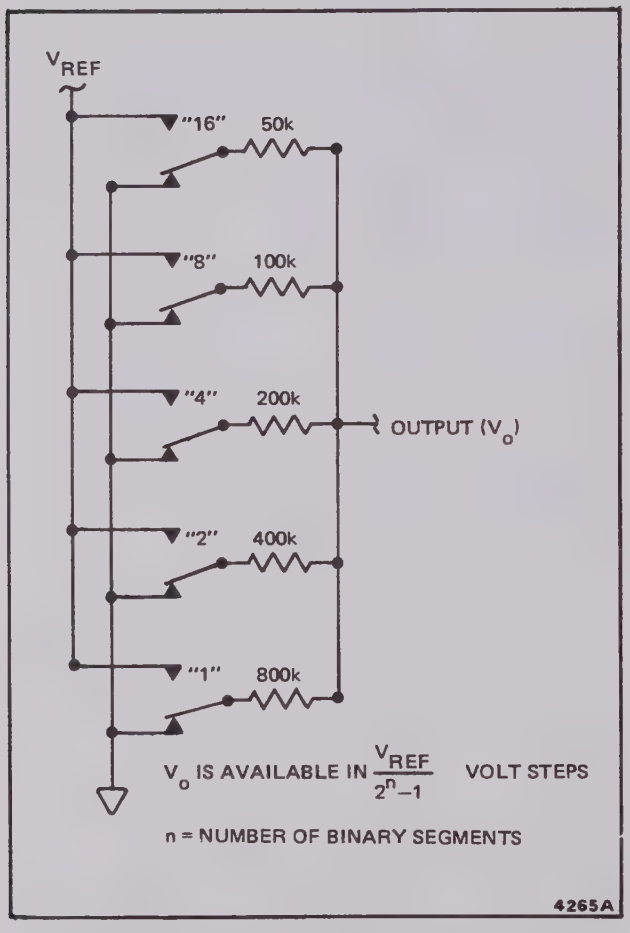


Figure 3-3. BINARY LADDER (SIMPLIFIED)

3-40. DRIVERS. Each ladder resistor is connected to V_{REF} common using a driver such as the one shown in simplified Figure 3-4. When the bit command is high (0V), QA and QC are both turned off, which applies $-V_A$ to the gate of QB and $V_{R'}$ to the gate of QD. (Since $V_{R'}$ and V_{REF} are always at the same potential the gate-to-source voltage of QD will be 0V even if an ac reference is used). This condition switches QD on and QB off, thus applying V_{REF} through QD to the ladder resistor R_N. Absence of a bit command will apply a low (−5V) to the base of QA which causes it to conduct. The resulting 0V collector signal switches on gate QB and the driver QC. Conduction

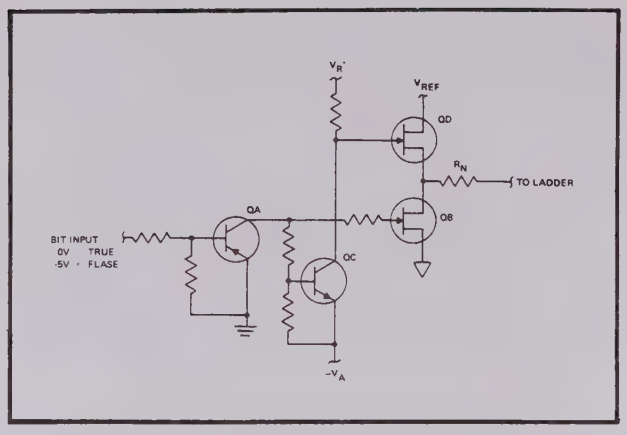


Figure 3-4. LADDER DRIVER (SIMPLIFIED)

of QC applies $-V_A$ to the gate of QD, turning it off. As a result, V_{REF} common is applied through QB to the ladder resistor R_N.

3-41. A6 Isolated Control Logic (4275A-1021)

3-42. The A6 Isolated Control Logic assembly receives and processes all input and output data at the Programming Connector, J1. A logic diagram in simplified form is shown in Figure 3-5. Logic timing is illustrated in Figure 3-6.

3-43. PRESET GENERATORS

3-44. Two Preset Generators are used in the Isolated Control Logic. Their purpose is to preset all counters, flip-flops, and registers to their proper state when the supply is first turned on. This is to insure that the output of the power source is programmed to its minimum value, and that all logic is in the proper state to accept input data and process it properly upon command. One Preset Generator is used to preset the input programming circuitry and is composed of Q8 and Q5. When input power is applied, the $+V_L$ supply rises to its regulated level of +5 volts. At this point C5 has not been charged, and Q8 and Q5 are turned off, leaving the preset line high. C5, driven by the current from the +5V supply begins to charge C5 at a linear rate. The voltage divider composed of R9 and R10 provides a +4V reference to the gate of a Programmable Unijunction Transistor, Q8. When the charge on C5 reaches approximately +4.5V, the gate of anode Q8 is forward biased causing it to turn on and latch. C5 now begins to rapidly

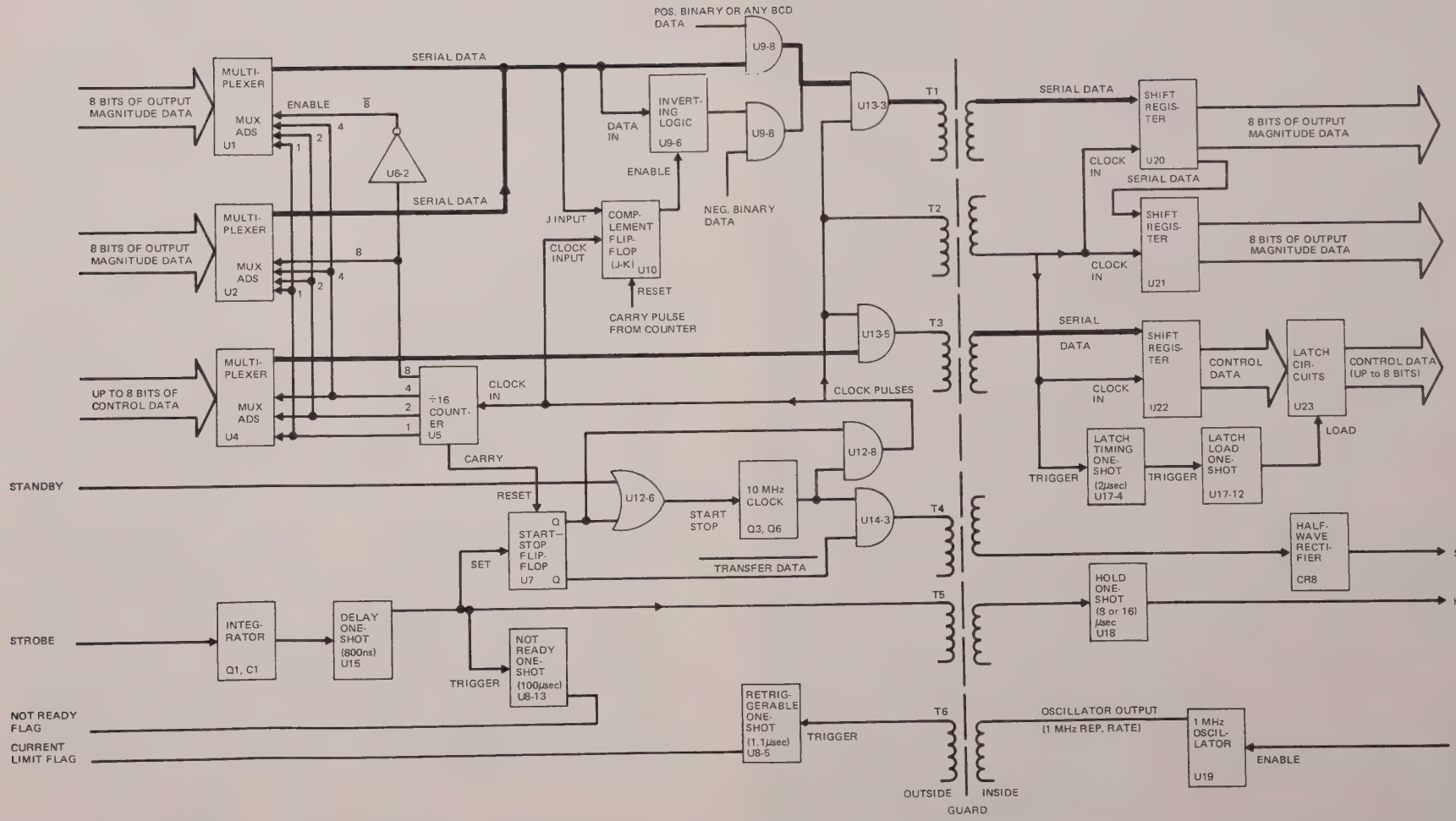


Figure 3-5. ISOLATED CONTROL LOGIC (Simplified)

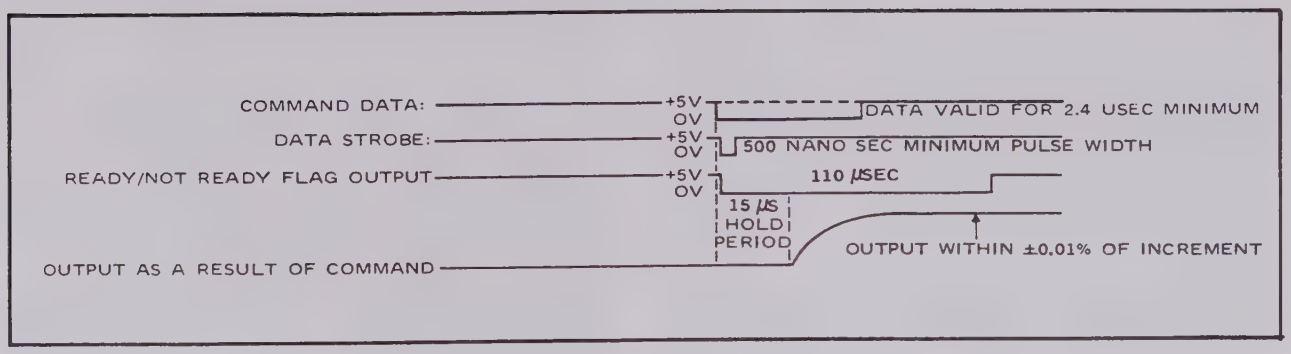


Figure 3-6. ISOLATED CONTROL LOGIC TIMING

discharge through Q8 and R11. The voltage developed across R11 is sufficient to turn on Q5, which causes the preset line to go low, thereby presetting all input programming circuitry. When the discharge of C5 is almost complete, the voltage drop across R11 can no longer supply base drive to Q5; it therefore turns off, allowing the preset line to return to its high state.

3-45. The second Preset Generator is used to preset the shift registers in the isolated portion of the logic circuitry. It is composed of Q16 and Q15 and is less complex than the preset generator previously described. When input power is applied, the $-V_L$ supply rises to its regulated level of −5V. At this time Q16 is not conducting, C33 is not charged, and the output of U15 is −1V. C33 now begins to charge at an exponential rate through R57. R54 and R55 form a voltage divider which provides a −1V reference to the gate of a Programmable Unijunction Transistor, Q16. When the charge on C33 reaches approximately −0.5V, the gate to anode of Q16 is forward biased causing it to turn on and latch. C33 now begins to rapidly discharge through Q16 and R58. The voltage developed across R58 drives the input of Q15 toward 0V, causing its output to drive close to −5V and clear shift registers U20, U21 and U22. As the discharge of C33 is almost complete, the voltage drop across R58 approaches zero volts allowing the input of Q15 to return to a −5V level. The output of Q15 then returns to 0V, completing the preset pulse. Q16, however, remains latched because of the small holding current supplied through R57.

3-46. DATA TRANSFER SEQUENCE

3-47. The parallel program data (output voltage magnitude, sign, output voltage range, current limit magnitude and external reference function) is applied to the inputs of a series of multiplexing circuits as shown in Figure 3-5. When the data is settled at the multiplexer inputs, the program source generates a strobe signal having a duration of nanoseconds or longer. The strobe pulse is fed via an integrator to the trigger input of a delay one-shot. The integrator provides noise immunity, and triggers the delay one-shot when it receives a pulse having a width of 800 nanoseconds or greater. The delay one-shot produces an 800 nanosecond pulse, the leading edge of which triggers the hold one-shot (via T5) to produce an eight or 16 microsecond pulse to the hold input of the power source. The width of the hold one-shot output pulse depends upon the particular power source model. That is, the 4210A and 4216A require an eight microsecond hold pulse, while the remaining models require a 16 microsecond hold pulse. In either case, the hold pulse is used within the A3 assembly to hold the output voltage magnitude constant while programming is underway.

3-48. The trailing edge of the delay one-shot output triggers the not ready one-shot and sets the start/flip-flop. The not ready one-shot generates a 100 microsecond pulse which becomes the not ready flag output to the program source. The not ready flag indicates that the 4200-09 is busy and not available to accept program data or strobe signals from the program source. When the strat/stop flip-flop becomes set, the Q output provides a start signal (voltage level) to the start/stop input of a 10 MHz clock. The Q output of the start/stop flip-flop is also fed to an input of gate U12-8 to gate the clock output pulses to various portions of the control logic to transfer the program data across the guard. Concurrently, the Q output of the start/stop flip-flop inhibits gate U14-3 to prevent clock pulses from reaching the primary winding of T4. (This function is described in later paragraphs.)

3-49. The 10 MHz clock pulses gated by U12-8 are fed to the input of a ÷16 (four-bit binary) counter. At the time of the sixteenth clock pulse, the counter reaches full count and generates a carry pulse to the reset input of the

start/stop flip-flop (and also to the reset input of the complement flip-flop described later). As the counter advances through its 16 states, the four binary-weighted (1, 2 4 and 8) outputs address the multiplexer channels and move the bits of data applied to the parallel inputs over to the multiplexer output. For example, the first clock pulse to the counter advances it from the zero state to the first state in which the "1" output is true and the "2", "4" and "8" outputs are false. As a result, the second channel of U1 and U4 is addressed, and the second bit of data appears at the multiplexer outputs. As the counter advances, the subsequent inputs of U1 and U4 appear at the multiplexer outputs, until the count of eight is reached. At this point, the "8" output becomes true to inhibit U1 and enable U2. The eight inputs of U2 are sequentially addressed in the same manner as U1 and the program data appears in serial format at the U2 output, and is commonly connected with the U1 output. During the 16-state cycle of the counter, U1 and U2 are each cycled once, while U4 is cycled through its eight addresses twice. This is of no consequence since input data has not changed during the generation of the 16 clock pulses.

3-50. The 16 clock pulses are fed to inputs of gates U13-3 and U13-5 to gate the serial program data appearing at the multiplexer outputs to the primaries of T1 and T3. The clock pulses are also fed directly to the primary of T2. The transformers couple the signals across the guard. On the inside of the guard, the clock pulses are applied to three eight-bit shift registers causing the registers to load the serial program data. Shift registers U20 load the 16 bits of output magnitude data while U22 loads (twice) up to eight bits of control data. The parallel outputs of U20 and U21 are applied directly to the ladder network assembly (A5), while the parallel outputs of U22 are applied to a series of latch circuits. To load the control data into the latch circuits, the first of the 16 clock pulses triggers a latch-timing one-shot which has a period of two microseconds. This one-shot is not re-triggerable by the subsequent clock pulses, and the trailing edge of the output pulse occurs after the clock pulses and serial transfer of data into the shift registers is complete. The trailing edge triggers the latch load one-shot to parallel load the eight bits of control data from the shift register into the latch circuits for application to the control circuits within the power source.

NOTE!

Complementing magnitude data occurs only in binary-type power sources.

3-51. COMPLEMENTING BINARY DATA

3-52. Binary-type power sources require that negative values of magnitude data be two's complemented since binary program sources usually indicate polarity by means of a single bit and supply two's complemented magnitude data for negative outputs. The binary-type power sources require non-complemented binary data plus a polarity bit. As a result, negative binary magnitude data, consisting of complemented data, must be re-complemented to satisfy the requirements of the power source. When the binary program source indicates negative sign, gate U9-8 is enabled to pass the output of the complementing logic. The complementing logic receives the serial output of U1 and U2, complements it, and passes it across the guard via T1.

3-53. Operation of the two's complementing logic (U9 and U10) is such that the first bit of serial data (multiplex address zero) is present at the output of multiplexer, U1, before the ÷16 counter and a complement flip-flop (U10) receives the first of 16 clock pulses. At this time, the ÷16 counter is in its zero state to address channel zero of U1, and the complementing flip-flop is still reset (as a result of the carry pulse generated by the ÷16 counter at the end of the previous data transfer sequence). With the complement flip-flop reset, the complement logic is not enabled and no inversion of serial data takes place. This condition permits the first binary magnitude data to be transferred without being complemented. However, after the first clock pulse, the complement flip-flop may be allowed to go set (to enable the complement logic) depending upon the state of the J input, which is derived from the serial data. As a result, the complement flip-flop goes set at the time of the first true bit of serial data is enable the inverting logic and complement the remaining bits of serial data. After the 16th bit of data, the complementing flip-flop is reset by the carry output of the ÷16 counter.

3-54. STANDBY OPERATION

3-55. The power source can be commanded to standby or operate mode at anytime by the program source. As shown in Figure 3-5, the standby command (dc) is gated to the start input of the 10 MHz clock. The clock is turned on and generates pulses as long as the standby signal is present. The start/stop flip-flop remains reset from the last transfer sequence to enable gate U14-3 and pass the clock pulses via T4 to a half-wave rectifier on the inside of the guard. The dc output of the rectifier becomes the standby signal for control of the power source. During standby operation, data transfer does not take place due to the

start/stop flip-flop being reset and gate U12-8 being inhibited.

3-56. CURRENT LIMIT FLAG

3-57.. The current limit flag produced by the A9 Power Amplifier whenever the power source is in the current limit mode, is used to enable a 1MHz oscillator (U19) which produces pulses at a 1MHz rate. The pulses are fed via T6 to the trigger input of a re-triggerable one-shot having a period of 1.1 microseconds. As long as the 1MHz pulses occur, the output of the re-triggerable one-shot is held at dc level which becomes the current limit flag to the program source.

3-58. A3 Preamplifier (4265A-1051)

3-59. The A3 Preamplifier produces a drive signal proportional to the input programming commands. This drive signal is applied to the A9 Power Amplifier which, in turn, produces the power source output. The circuitry consists of the four most significant bits of the binary ladder and associated switches and drivers, ladder clamps, voltage range switches, high impedance input stage, sample and hold, and output stage.

3-60. BINARY LADDER. The four most significant bits of the Binary Ladder consist essentially of R26, R27, R29, and R31. Their individual resistance values weigh the division factor necessary to scale V_{REF} in respective 8192, 4096, 2048, and 1024 portions. Selection of individual ladder resistors is done through associated ladder switches. Variable resistors R28, R30, and R32 allow precise calibration of the 4096, 2048, and 1024 ladder portions to the 8192 portion. The resulting scaled V_{REF} from these ladder portions is combined with the A5 Binary Ladder input through R25 and applied to the input of Q18A. Feedback from the HIGH SENSE terminal at the output of the power source through resistances selected by the Voltage Range Switches drives the input to Q18 to virtual analog common, in the manner of a high-gain operational amplifier.

3-61. LADDER SWITCHES and DRIVERS. The Ladder Switches and Drivers Q1 through Q16, apply V_{REF} or analog common V_A common, to the ladder resistors under control of the 8192, 4096, 2048, and 1024 bit commands. Each Ladder Switch-Driver combination functions in the same manner; thus only operation of the 8192 bit is described.

3-62. The 8192 ladder resistor is connected to V_{REF} or analog common through Q1 and Q2 or Q3, respectively. When an 8192 command (0V) exists at terminal 18 of P1, both Q4 and Q5 will be switched off. Q3 is switched off by its resulting $-V_A$ gate voltage and Q1, Q2 are switched on by the resulting $V_{R'}$ gate voltage. With Q1 and Q2 conducting, V_{REF} is applied to R26. Absence of an 8192 command applies –5V to terminal 18 of P1 and switches Q4 and Q5 on. The resulting 0V gate voltage at Q3 switches it on and applies analog common to R26. Q1 and Q2 are switched off by conduction of Q5, which applies $-V_A$ to their gates.

3-63. LADDER CLAMPS. The Ladder Clamps consisting of CR5, CR6, R47 and R48 limit the summing junction voltage at the input of Q18. Clamp signals at terminals 7, 19, and W of P1 turn on CR5 or CR6 during a current limit condition. This minimizes any output voltage transients at the output of A9 Power Amplifier if the load causing the current-limit condition is suddenly removed.

3-64. VOLTAGE RANGE SWITCHES. The Voltage Range Switches and Drivers consisting of Q30 through Q34 select the appropriate feedback resistance and frequency compensation for the 16V and 65V range. In the 16V range, a –5V command is present at terminal 14 and R of P1. This voltage turns off Q34 and Q33, which, in turn, switch on FET gates Q30 through Q32. Conduction of Q31 and Q32 connects R39, R40, R42, and R43 across R36 and R35. The end of this network that connects to pin 4 of P1 ultimately becomes the HIGH SENSE terminal at the output of the power source. The frequency response of the Preamplifier in both voltage ranges is controlled by Q30. In the 16V range, conduction of Q30 by-passes R34 and C2, thus connecting only R33 and C1 to the Preamplifier output. In the 65V range, a 0V command at terminal 14 and R of P1 turns on Q34 and Q33 which turns off Q30 through Q32. With Q31 and Q32 off, only R35 and R36 are connected to the power source output (HIGH SENSE), thus increasing the total feedback resistance by four. The resulting output voltage is subsequently four times the binary input commands. With Q30 off in the 65V range, R33, C1 and R34, C2 are connected in series to establish the desired frequency response.

3-65. HIGH IMPEDANCE INPUT STAGE. Differential amplifier Q18 amplifies the Binary Ladder output with respect to analog common, V_A common, such that feedback through resistance selected by the Voltage Range Switches produces a virtual analog common at the input of Q18A. Transistor Q19 functions as a constant current source, and

Q20 provides temperature compensation. Variable resistor R61 provides adjustment to compensate for the input offset of Q18. Jumper selection of R57 through R59 and R62 provides coarse offset adjustment. Selection of R_P and R_N in the drain circuit of Q18 is done to provide a low temperature coefficient of input offset voltage. Diodes CR7 through CR12 limit the maximum voltage swing applied to the following stage.

3-66. SAMPLE AND HOLD. The Sample and Hold circuitry consists of MOSFET gates Q21, Q22, driver Q23, and capacitors C1 and C11. These capacitors provide memory during programming changes. Normally, a HOLD command (0V) is present at terminal P of P1 and Q23 is conducting. This condition turns on Q21 and Q22 and the output of Q18 is amplified by Q24, Q25. During programming changes, however, presence of a HOLD command (−5V) at terminal P of P1 turns off Q23 and Q21, Q22. Capacitors C1 and C11, which are connected to the inputs of Q24, then hold a sample of the last input from Q18 and hold the output voltage relatively constant for the duration of the HOLD command. The HOLD period is short enough and the circuit constants are chosen so that negligible output voltage change occurs. A secondary HOLD circuit composed of U1 and Q35 through Q37 provides a clamp to analog ground at the input of Q18 during the HOLD period. Presence of a HOLD command (−5V) presets J-K flip-flop U1 to provide a low Q output, which turns on Q37. Q36 is switched on by the resulting $-V_L$ common base signal and turns on Q35, which applies analog common to the base of Q18.

3-67. Transistor Q26 functions as high impedance constant current source for Q25B. Q27 and Q28 amplify the output of Q25B and furnish a drive signal to Q29.

3-68. OUTPUT STAGE. Emitter follower Q29 provides a low impedance output signal at terminal 5 of P1. This signal is applied to the A9 Power Amplifier which then produces the power source output.

3-69. A9 Power Amplifier (4265A-1071)

3-70. The A9 Power Amplifier produces the final output voltage and current of the power source. It also provides both source and sink current limit protection of the bipolar output. The circuitry consists of an input amplifier, driver, clamp circuitry, current sources, output stage, and current limit detector.

3-71. INPUT AMPLIFIER. The Input Amplifier composed of Q9 through Q11 and Q20 through Q25 amplifies the input appearing at terminal D of P1. The resulting voltage at the emitter of Q11 corresponds closely to the programmed output voltage. A closed-loop dc gain of five is established by feedback through R62 and R21. Overall frequency response is controlled to 6 db per octave by C6. Amplifiers Q22 and Q23 link V_U common to the A3 Preamplifier common (V_{REF} common) such that current flow between these two points is minimized. Q20 and Q21 provide current with respect to the common established by Q23, Q22 emitters. Emitter follower Q9 and amplifier Q10 provide voltage gain and a drive signal to the output emitter follower Q11. Overall frequency response to this point is controlled with feedback through C6. The resulting emitter voltage of Q11 is close to the final output voltage of the power source. Transistors Q24 and Q25 function as current sources for Q10 and Q11, respectively.

3-72. DRIVER. The Driver consisting of Q12 and Q26, form complementary current amplifiers. These amplifiers receive a bipolar drive voltage from Q11 and together with the CURRENT SOURCES produce respective drive currents for the output stage. The voltage drops across Q13, CR33, Q17, and CR27 together with variable resistor R51 set the bias current required for the output transistors Q32, Q33, Q41, and Q42. Q13 collector current is turned off when a (+) current limit condition exists and Q17 is affected similarly for a (−) current limit. These collectors drive the CURRENT LIMIT DETECTOR.

3-73. CLAMP CIRCUITRY. Voltage transients that would occur during a current limit and abrupt load removal are limited by the Clamp Circuitry. Two circuits titled + Clamp and − Clamp limit the bipolar transients. The + Clamp consists of Q1 through Q4. Transistors Q5 through Q8 form the − Clamp. Since operation of each circuit is the same, except for polarity, only the + Clamp is described.

3-74. The +Clamp monitors the voltage between the emitter of Q11 and that on the anode of CR33. Normally, Q1 and Q2 are cut-off and Q3 is conducting; however, when a current limit occurs, the anode voltage of CR33 decreases through action of either the built-in current limiter (overload protection) or the A8 Programmable Current Limiter (optional) and subsequently turns off Q3. The voltage at the emitter of Q11, will increase toward $+V_U$ during current limiting and this turns on Q2. Conduction of Q2 turns on Q1 and produces a clamp signal at terminal 6 of P1. This clamp signal then limits the summing junction voltage in the A3 Preamplifier and causes the emitter voltage of Q11 to be clamped to a voltage slightly above that of the base drive to the Output Stage. Transistor Q4 functions as a current source for Q2 and Q3. Frequency and phase

characteristics of the + Clamp circuitry is determined by C1, C2, C26 and R65.

3-75. CURRENT SOURCES. Constant current for the Output Stage is provided by the Positive and Negative Constant Current Sources. Transistors Q27 through Q30 form the Positive Constant Current Source. The Negative Constant Current Source Consists of Q36, Q38, Q39, and Q40. Since operation of each circuit is the same, except for polarity, only the Positive Constant Current Source is described.

3-76. The Positive Constant Current Source produces a constant reference current for the base of Q31. Zener CR23 produces a fixed bias for Q29, which provides a constant current through CR21, CR22, Q27, and R32 regardless of variations in $\pm V_U$. Subsequently, Q28 and Q30 receive fixed base current through these elements. The resulting constant current through Q28 and Q30 then provides a constant reference current for the base of Q31. Temperature compensation of the V_{BE} of Q28 is provided by diode-connected Q27.

3-77. OUTPUT STAGE. The Output Stage consisting of Q31 through Q35 and Q37 through Q42 produces the power source output. It also provides both sourcing and sinking current limit protection.

3-78. Transistors Q31 through Q33 and Q37, Q41, Q42 form a complementary, emitter follower stage. Q31 through Q33 produce the positive output and Q37, Q41, Q42 the negative. Total output current flows through R43, R44 (positive) and R47, R48 (negative).

3-79. Both sourcing and sinking current limit protection is provided for each section of the output amplifier. Q34 protects the positive output section and Q35 the negative. Maximum output current (sourcing) is limited to 1.2A. Sinking current is limited at a lesser value depending on the programmed output voltage. Since operation of each current limiter is the same, only the positive output section protected by Q34 is described.

3-80. Output current passes through R43 and R44. This current produces a bias voltage for Q34. When the output current (sourcing) exceeds 1.2A, the resulting potential turns on Q34. Conduction of Q34 via CR34 shunts any further base drive current to Q31, thus limiting the maximum sourcing output current at 1.2A. In the sinking mode, output current will pass through R43 and R44 to the output as above, but the output voltage polarity is zero or negative by definition. Under this condition, negative voltage more than −0.6V at the output will turn on CR25 which supplies base current for Q34 through R41 from common and adds to that supplied from the voltage drop across R4 and R44. Therefore, the base current is dependent on both sinking voltage magnitude and output current. Current limiting in milliamperes is equal to $1000\text{-}10E_{out}$.

3-81. When the A8 Programmable Current Limiter −06 Option is installed, ±I LIMIT inputs are applied to terminals 2 and 10 of P1. These inputs clamp the maximum base drive to both sections of the Output Stage in a similar manner to Q34, thus limiting the maximum output current at a level determined by the input current limit commands.

3-82. CURRENT LIMIT DETECTOR' The Current Limit Detector produces an I LIMIT (0V) command at terminal 14 of P1 whenever a source or sink limit condition exists. Circuitry consists of Q14 through Q16, Q18, and Q19. Positive output section limiting is detected by Q14. Limiting in the negative output section is detected by Q18. Transistors Q15, Q16, and Q19 are drivers.

3-83. Under normal operating conditions Q14 and Q18 are turned on by conduction of Q13 and Q17 in the Driver. Transistors Q15 and Q19 are switched off by conduction of Q14 and Q18, thus turning Q16 on and producing an I LIMIT (−5V) command at terminal 14 of P1. Should a current limit occur in the positive or negative section of the Output Stage, the associated Q13 or Q17 in the Driver will be turned off. This turns off Q14, Q15 or Q18, Q19, thus turning Q16 off and producing an I LIMIT (0V) command at terminal 14 of P1.

3-84. A8 Programmable Current Limiter (4250A-1081)

3-85. The A8 Programmable Current Limiter is installed as the −06 Option. It compares the voltage from a ladder network to an input voltage proportional to the output current. When the output current exceeds the ladder network reference, a clamp signal is produced that is used to limit the output current of the A9 Power Amplifier. The A8 Programmable Current Limiter contains the following circuitry: an 8-4-2-1 to 4-4-2-1 binary code converter, FET drivers, a ladder voltage reference, ladder switches and a ladder, a programmable reference and programmable reference inverter, and two current limit comparators - one positive and the other negative. Auxiliary circuits are a ground isolator and two power supplies, one 15 volts and the other −16 volts. A one-ohm current sampling resistor is tied to the input of the two current limit comparators.

3-86. 8-4-2-1 to 4-4-2-1 CONVERTER. This logic converter consists of two, digital integrated circuit, hex-inverters U1A through U1F and U2A through U2F. They convert the input 8-4-2-1 code to 4-4-2-1 code, and in the absence of any programmed inputs, program the ladder to the lowest current limit, 10 milliamps. This is the quiescent state of the limiter in which ladder switch Q4 and the current range switch Q26 are turned on, placing operational amplifier U4 in low range. This ensures that the Model 4265A current limits at the lowest current, 10 milliamps, as a safety feature. In the event a programmed input for 80 milliamps is applied to the converter, the logic input is applied to two circuits, one directly to the base of FET Driver Q13 and the other indirectly through two inverters U2F and U1A to the base of FET Driver Q10. These two drivers turn on ladder switches Q9 and Q12 and two code 4 ladder resistors, thereby applying an equivalent 8 to the Programmable Reference amplifier and establishing a current limit of 80 milliamps.

3-87. FET DRIVERS. The ladder FET DRIVERS consist of PNP-NPN Transistor pairs Q3-Q5, Q7-Q8, Q13-Q14, and Q10-Q11. The emitters of these pairs as well as the current range FET drivers Q15-Q16, are returned to V_L common through a ground isolator network consisting of transistors Q1 and Q2. The ground isolator network is described later. The purpose of the drivers is to increase the voltage output of the converters to a level required by the FET switches.

3-88. LADDER VOLTAGE REFERENCE. The Ladder Voltage Reference consists of a temperature compensated, 6.3 volt zener diode CR7 and produces a stable reference voltage that is reduced to 0.1 volt at TP3 by resistors R4, R6, and R59. This voltage reference is supplied by the regulated +15 volts power supply (TP2) consisting of 16 volt zener CR1, transistor Q28, and associated components.

3-89. LADDER SWITCHES AND LADDER. The Ladder Switches and Ladder, respectively, consist of FET switches Q4, Q6, Q12, and Q9 and resistors R52, R55, R54, and R15. The ladder resistors are weighted in a ratio of 1, 2, 4, and 4. The ladder operation is best explained in conjunction with the Programmable Reference. (See paragraph 3-96).

3-90. PROGRAMMABLE REFERENCE AMPLIFIER. Programmable Reference Amplifier U4 is a monolithic IC operational amplifier. Assuming current range switch Q26 is on, then U4 output voltage varies between −0.01 volt and −0.11 volt as the ladder resistors are switched into the circuit by the FET switches. That is, with only Q4 on, the output voltage is −0.01 volt. With Q4, Q6, Q12, and Q9 on, the output voltage is −0.11 volt. The range is set by R31 in parallel with R30 and is the 10 ma to 110 ma current range. With Q26 turned off, the range is determined by R30 alone. This is the 100 ma to 1.1 ampere range (Current Limit x 10 command) in which the ladder resistors produce an output from U4 of −0.1 volt to 1.0 volt. Amplifier U3, also a monolithic integrated circuit, together with resistors R24 and R25, forms a unity gain, inverting amplifier. The output of U3 is the same magnitude as that of U4, but of opposite polarity.

3-91. POSITIVE AND NEGATIVE I LIMIT COMPARATORS. Since the comparators function in the same manner, except for polarities, only the positive comparator is described. The output current from the Model 4265A flows through a one-ohm resistor, R51. A *positive* output current through this resistor produces a positive voltage that is compared to the output of U3 by action of transistor Q17. When the positive output of U3 is greater than the positive voltage developed across R51, Q17B is on and Q17A is off, as are Q18, Q19, and Q17. This corresponds to the Model 4265A output current being less than the programmed I-limit. When the positive output of U3 is less than the positive voltage developed across R51, Q17A, Q18, Q19, and Q27 are all on and conducting. The greater the difference between the R51 and U3 voltages, the greater these transistors conduct. The collector of Q27 connects, by way of pin 2 of P1, to the base of Q31 on the A9 Power Amplifier. When the Q27 collector conducts, it shunts base current drive away from Q31, as described in paragraph 3-87, thus limiting the Model 4265A output current to the programmed level. Transistors Q18 and Q27 are common-base stages used as voltage translators: Q18 from the −10 volts level of Q17A to Q19 which is referred to V_U (about −100 volts), and Q27 from Q19 to essentially the OUTPUT HIGH terminal voltage. Transistor Q19 provides current gain and Q20 is used as a temperature compensating diode for Q19. Capacitor C4 and resistor R40 are the primary frequency response determining components. Transistor Q25A and Q25B compares a negative reference voltage to negative voltages produced across resistor R51 by the output current in a manner similar to Q17A and Q17B. Transistors Q24, Q21, Q23, and Q22 correspond in function to Q18 through Q20 and Q27, respectively.

3-92. GROUND ISOLATOR. The Ground Isolator circuit, composed of transistors Q1 and Q2 isolate the ground currents flowing in V_U COMMON from those in V_L COMMON. The input logic lines driving the first transistor of each pair of FET Drivers (the emitters of the drivers) are referenced to V_L COMMON indirectly through transistors Q1 and Q2. Thus, the only current through the point of commonality of V_L - V_A - V_U is the base

current of Q1 and this has but a negligible effect in the OUTPUT LOW sense line.

3-93. MINUS 16 VOLTS POWER SUPPLY. Diode CR2, a 16 volt zener, produces −16 volts at test point 4. This voltage is used in the Ground Isolator, the FET Drivers, and U3 and U4.

Section 4
Maintenance

4-1. INTRODUCTION

4-2. This section contains servicing information for the Model 4265A. Table 4-1 lists the required test equipment. If the recommended equipment is not available, substitute equipment with equivalent specifications can be used.

Table 4.1 RECOMMENDED TEST EQUIPMENT

NOMENCLATURE	EQUIPMENT
AC/DC Voltmeter	FLUKE Model 887A
Manual Control Unit (MCU)	FLUKE Model A4200
*AC Source, 100 Hz, 30 kHz	FLUKE Model 510A (2)
**Resistive Load	10 ohm ±1%, 20w

*Required only if –03 Option is installed.
**Required only if –06 Option is installed.

4-3. SERVICE INFORMATION

4-4. All products manufactured by the John Fluke Mfg. Co., Inc. are warranted for a period of one year. Complete warranty information is located in the WARRANTY at the front of the manual.

4-5. Factory authorized calibration and service is available at various world-wide locations. A complete list of Factory Authorized Service Centers is located at the rear of the manual. If requested, an estimate will be provided before repair work is done on an instrument that is beyond the warranty period.

4-6. GENERAL MAINTENANCE

4-7. Cleaning

4-8. This power source should be cleaned periodically to remove dust, grease, or other contaminates. The exterior can be cleaned with a cloth moistened with anhydrous ethyl alcohol or Freon T.F. Degreaser (MS 180) Miller Stephensen Chemical Co., Inc.) If either of these cleaning agents are not readily available, soap and water applied sparing to a cloth can be used. Cleaning of the interior sections is done using clean, dry air at low pressure.

4-9. Air Filter Cleaning

4-10. An air filter is installed on the rear panel blower assembly. This air filter should be removed and cleaned periodically to remove accumulation of dust and grease. The air filter is easily removed by pulling it free from the blower assembly. Cleaning is done using solvent and a brush or mild soap and warm water.

4-11. Fuse Replacement

4-12. The input power fuse is located on the rear section of the power source. If replacement is necessary, use the following rated fuse:

115V AC LINE	230V AC LINE
2A, AGC	1A, AGC

4-13. MAINTENANCE ACCESS

4-14. Access to the interior section of the power source shown in Figure 4-1 is done as follows:

a. Disconnect the power cord from line power.

b. Remove the top dust cover. Access is now provided to calibration adjustments and test points. Adjustments are labeled on the two inner covers.

c. Remove the two inner covers. Access is now provided for removal of the A3 through A5 or A8 pcb assemblies.

d. Removal of an A3 through A5 or A8 pcb assembly is done using a gentle rocking motion and even pulling force.

NOTE!

PCB assemblies can be mounted on an Accessory Extender card for servicing. Information regarding the Extender card is given in Section 6.

e. Removal of the A9 pcb assembly is done by first removing the screws which attach the heat sink to the bottom inner chassis. The pcb is then removed in the same manner as described in step d.

f. Removal of the A2 or A6 assembly is done from the rear panel. First remove the mounting screws at the rear panel and then pull the pcb assembly out through the rear panel.

NOTE!

The A2 pcb must be mated with the A10 pcb for servicing. An interface cable is available from the John Fluke Mfg. Co., Inc.

g. Access to the A1 and A7 pcb assemblies is possible after removing the front panel. First, remove the bottom dust cover and then remove the rack ears, if installed, from the front corner side panels. If the rack ears are not installed, peel the decals from the front corner panels. Next, remove the mounting screws which hold the transformer bracket to the A1 pcb assembly and then remove the screws from the front corner side panels. Pull the entire front panel assembly free of the instrument. Separation of the A1 and A7 pcb assemblies from the front panel is done by removing the large screws located on the A1 pcb. The A1 and A7 pcb assemblies can then be separated by removing the small screws on the A1 pcb and then pulling the pcb assemblies apart.

NOTE!

A grounding jumper located adjacent to the A2 pcb and transformer plugs into the A1 pcb. Ensure that this jumper is connected during installation.

h. Removal of the air filter and blower is done from the rear panel. First remove the air filter which snaps in place on the blower assembly. Next, remove the mounting screws which attach the blower cover to the rear panel and then remove the cover. Remove the screws which attach the blower to the rear panel and remove the blower. The interconnecting wiring is of sufficient length to allow servicing of the blower without disconnection.

4-15. CALIBRATION PROCEDURES

4-16. The power source should be calibrated every 90 days or annually, as desired, or whenever repairs have been made. Recommended test equipment is listed in Table 4-1. If the recommended test equipment is not available, substitute equipment having equivalent specifications can be used. Assembly, adjustment, and test point locations are shown in Figure 4-1. Binary and two's complement coding is shown in Table 4-2. This table provides a convenient reference for deriving two's complement coding required for negative outputs when the Isolated Logic (–01 Option) is installed.

4-17. Initial Procedure

a. Turn off the power source and then remove the top dust cover screws. Leave the cover in place.

b. Connect the Model A4200 (MCU) to the PROGRAMMING CONNECTOR on the rear panel of the power source.

CAUTION!

Ensure that the ±OUTPUT and SENSE terminals are properly connected on the rear panel of the power source.

c. Turn on the power source and select the Manual Mode and +0V output on the MCU.

NOTE!

Refer to A4200 subsection in Section 6 for operating instructions regarding MCU.

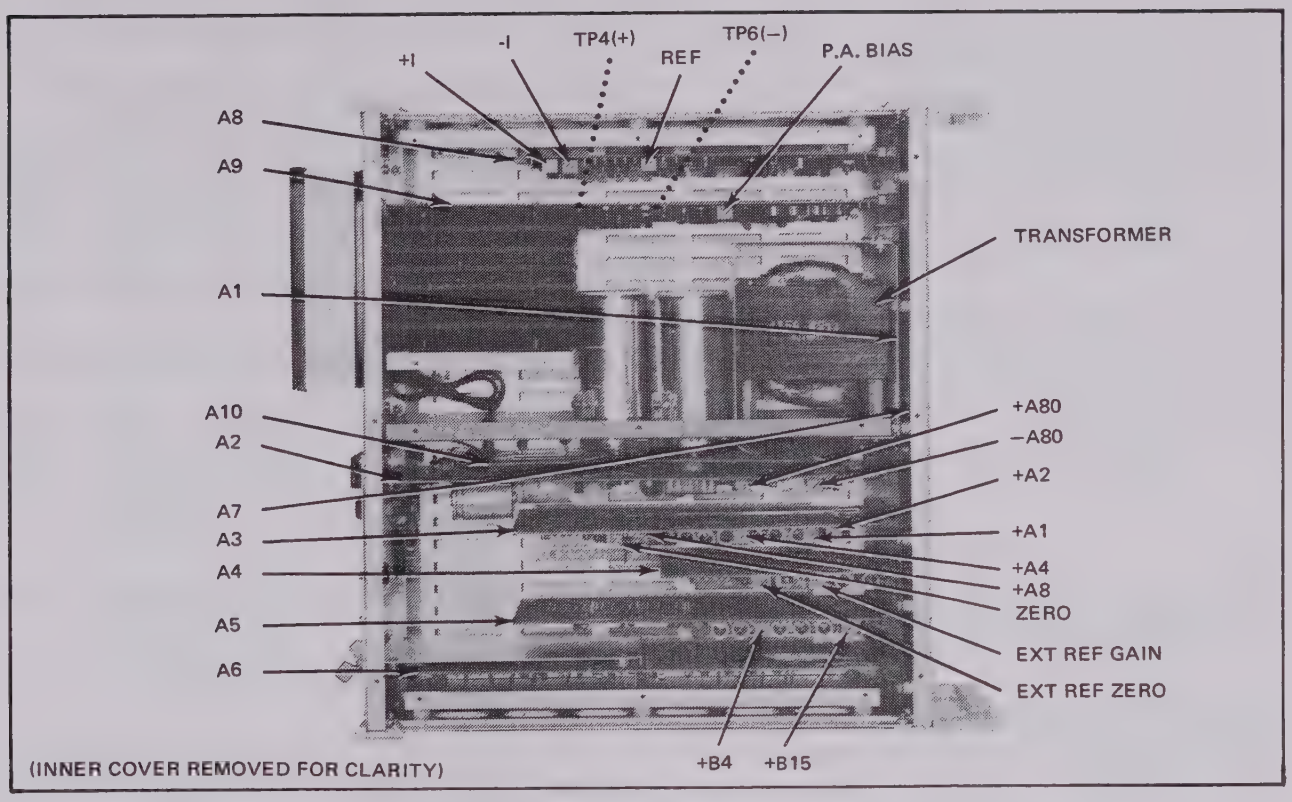


Figure 4-1. ASSEMBLY, ADJUSTMENT, AND TEST POINT LOCATIONS

TABLE 4-2. BINARY AND TWO'S COMPLEMENT CODING

BINARY CODE (S I G N 1 0 0 0 5 2 1 / 9 9 4 2 1 5 2 6 3 1 / 2 6 8 4 2 6 8 4 2 6 8 4 2 1)	OUTPUT VOLTAGE (VDC) 16V RANGE	OUTPUT VOLTAGE (VDC) 65V RANGE	TWO'S COMPLEMENT CODE (NEGATIVE OUTPUT) (S I G N 1 0 0 0 5 2 1 / 9 9 4 2 1 5 2 6 3 1 / 2 6 8 4 2 6 8 4 2 6 8 4 2 1)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1	0.001	0.004	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0	0.002	0.008	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0
0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0	0.004	0.016	1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0
0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0	0.008	0.032	1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0
0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0	0.016	0.064	1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0
0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0	0.032	0.128	1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0
0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0	0.064	0.256	1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0
0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0	0.128	0.512	1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0
0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0	0.256	1.024	1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0
0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0	0.512	2.048	1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0
0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0	1.024	4.096	1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0
0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0	2.048	8.192	1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0
0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0	4.096	16.384	1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0
0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0	8.192	32.768	1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0

Binary Code Addition

Desired Output = 12.288V
12.288V = 8192 + 4096 bits

or

```
  0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
+ 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0
-----------------------------------
  0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0
```

Two's Complement Code Addition

Desired Output = −12.288V
−12.288V = (−8192) + (−4096) bits

```
  1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
+ 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0
-----------------------------------
(disregard carry 1) ← 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0
```

SIMPLIFIED METHOD (−12.288V)

1. Note positive output code:
   0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0
2. Starting from the right, copy first bit 01(1)000000000000 and then invert all remaining bits (10)1000000000000.
3. −12.288V = 101000000000000

d. Allow the power source to operate for ½ hour and then remove the top dust cover.

4-18. Power Amplifier Bias Adjustment

a. Call 65V range and a +0V output on the MCU.

NOTE!

If the A8 Current Limiter (–06 Option) is installed, call a current limit of 1.1A.

b. Connect the input of a dc voltmeter to TP4 (+) and TP6 (–) of the A9 assembly. These test points are accessible through slots in the inner cover.

CAUTION!

The test leads of the voltmeter must be fully insulated to avoid contact with the inner cover.

c. The voltage at TP4 should be +80 mV dc ±16 mV. If necessary, adjust P.A. BIAS to obtain the correct voltage.

d. Disconnect the dc voltmeter from the A9 assembly.

4-19. Zero, Reference and Bit Adjustments

a. Call 65V range and a +0V output. Also connect a dc voltmeter, observing proper polarity, to the OUTPUT terminals of the power source.

b. Adjust A3, ZERO for a 0 ±30 uV output from the power source.

c. Call 16V range and a +0V output. The output of the power source should be 0 ±10 uV. If necessary, adjust A3, ZERO until the specified outputs of step a. and c. are obtained.

d. Call 65V range and a –32.768V output (8192 bit and –SIGN bit).

e. Adjust A2, –A80 for a –32.768V dc ±1 mV output.

f. Call 65V range and a +32.768V output (8192 bit).

g. Adjust A2, +A80 for a +32.768V dc ±1 mV output.

h. Call 65V range and a +16.384V output (4096 bit).

i. Adjust A3, +A4 for a +16.384V dc ±1 mV output.

j. Call 65V range and a +8.192V output (2048 bit).

k. Adjust A3, +A2 for a +8.192V dc ±100 uV output.

l. Call 65V range and a +4.096V output (1024 bit).

m. Adjust A3, +A1 for a +4.096V dc ±100 uV output.

n. Call 16V range and a +8.192V output (8192 bit).

o. Adjust A3, +A8 for a +8.192V dc ±100 uV output.

p. Call 16V range and a +960 mV output (512, 256, 128, and 64 bit).

q. Adjust A5, +B15 for a +960 mV dc ±10 uV output.

4-20. External Reference Adjustments (–03 Option)

4-21. If the A4 assembly is installed, perform the following adjustments:

a. Connect a shorting jumper between the EXT REF input terminals on the rear panel.

b. Call EXT REF, 16V range, and a +15.36V output (8192, 4096, 2048, and 1024 bit).

c. Adjust A4, EXT REF ZERO for a 0 ±10 uV output.

d. Disconnect the jumper from the EXT REF input terminals.

e. Apply a 10V ±1mV ac signal having a frequency of 100 Hz to the EXT REF input terminals. Use an ac voltmeter to verify the amplitude of the 100 Hz ac signal.

f. Reconnect the ac/dc voltmeter to the OUTPUT terminals. Ensure that the ac mode is selected on the voltmeter.

g. Call EXT REF, 16V range and a +10.24V output (8192 and 2048 bit).

h. Adjust A4, EXT REF GAIN for an ac voltmeter reading, at the output, of 10.2400 V ± 1 mV.

i. Call 16V range and a +0V output.

j. Disconnect the ac source from the power source and select the dc mode on the voltmeter.

4-22. Current Limiter Adjustment (–06 Option)

4-23. If the A8 assembly is installed, perform the following adjustments:

a. Call 16V range and a –0V output.

b. Connect a 10 ohm, 20w resistive load between the ±OUTPUT terminals on the power source. Ensure that the ac/dc voltmeter is still connected to the OUTPUT terminals and the dc mode is selected.

c. Call 16V range, current limit of 1A, and a –11V output (8192, 2048, 512, 128, 64, 32, 16, 8 and –SIGN bit for direct coupled logic or 4096, 1024, 256, 8, and –SIGN bit for isolated control logic).

d. Adjust A8, REF for a –10V dc ±25 mV output.

e. Call current limit of 10 mA and adjust A8, –I for a –100 mV dc ±1mV output.

f. Call a +11V output (8192, 2048, 512, 128, 64, 32, 16 and 8 bit) and adjust A8, +I for a +100 mV dc ±1 mV output.

g. Call a current limit of 1A, observing that the output is +10V dc ±250 mV.

h. Call 16V range, +0V output, and disconnect the 10 ohm, 20w load.

4-24. Final Zero Adjustment

4-25. The following adjustments must be performed after a minimum operating period of ½ hour with the dust cover in place.

a. Call 16V range and a +0V output.

b. Adjust A3, ZERO for a 0V ±10 uV output.

c. Call 65V range and a +0V output. The output should be 0V ±30 uV. If necessary, adjust A3, ZERO until the specified results of step a. through c. are obtained.

d. If the A4 assembly (External Reference –03 Option) is installed, call EXT REF, 16V range, and a +15.36V output (8192, 4096, 2048, and 1024 bit).

e. Connect a shorting jumper between the EXT REF input terminals on the rear panel.

f. Adjust A4, EXT REF ZERO for a 0V ±10 uV output.

g. Call 16V range, +0V output, and disconnect the jumper from the EXT REF input terminals.

4-26. Output Checks

a. Perform the 16V range linearity checks in Table 4-3, observing that the specified outputs are obtained.

b. If the A4 External Reference assembly (–03 Option) is installed, call 16V range and a +0V output.

c. Apply a 10V ac signal having a frequency of 30 kHz to the EXT REF input terminals. Record the input signal level with the ac/dc voltmeter used to monitor the power source output.

d. Reconnect the ac/dc voltmeter to the OUTPUT terminals. Ensure that the ac mode is selected.

e. Call EXT REF, 16V range, and a +10.24V output (8192 and 2048 bit). The output should be 10.24V ±3V.

g. Turn off the power source and disconnect the test equipment.

f. Call EXT REF, 65V range and a +10.24 output (256 bit). The output should be 10.24V ±3 V.

h. Install the top dust cover. Calibration is complete and the power source is ready for operation.

Table 4-3. LINEARITY CHECKS

CALLED OUTPUT (16V RANGE)		POWER SOURCE OUTPUT VOLTAGE (VDC)	CALLED OUTPUT (16V RANGE)		POWER SOURCE OUTPUT VOLTAGE (VDC)
SIGN (POLARITY)	BINARY CODE		SIGN (POLARITY)	BINARY CODE	
+	0	0 ±10 uV	+	4096	+4.096V ±200 uV
+	64, 4	+68 mV ±40 uV	+	4096, 1024	+5.12V +250 uV
+	128, 8	+136 mV ±40 uV	+	4096, 2048	+6.144V ±300 uV
+	128, 64, 8, 4	+204 mV ±40 uV	+	4096, 2048, 1024	+7.168V ±350 uV
+	256, 16, 1	+273 mV ±50 uV	+	8192	+8.192V ±400 uV
+	256, 64, 16, 4, 1	+341 mV ±50 uV	+	8192, 1024	+9.216V ±450 uV
+	256, 128, 16, 8, 1	+409 mV ±50 uV	+	8192, 2048	+10.24V ±500 uV
+	256, 128, 64, 16, 8, 4, 1	+477 mV ±50 uV	+	8192, 4096, 2048, 1024,	+16.383V ±1 mV
+	512, 32, 2	+546 mV ±50 uV		512, 256, 128, 64, 32,	
+	512, 64, 32, 4, 2	+614 mV ±50 uV		16, 8, 4, 2, 1	
+	512, 128, 32, 8, 2	+682 mV ±50 uV	−	1	−16.383V ±1 mV
+	1024	+1.024V ±50 uV			
+	2048	+2.048V ±100 uV			
+	2048, 1024	+3.072V ±150 uV			

Section 5
List of Replaceable Parts

5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown list of the instrument and a Cross Reference List of FLUKE stock numbers to original MANUFACTURERS' part numbers. It also lists recommended spare parts and contains part ordering information. The starting page number of each major listing is given in the Table of Contents.

5-3. The parts list shows the location of all assemblies and the replaceable components. Major assemblies are identified by a designation beginning with the letter A followed by a number (e.g., A1 etc). Subassemblies are identified in the same manner; however, the parent assembly designator precedes this designator (e.g., A1A1 etc.). Electrical components are identified by their schematic diagram designator and listed hardware parts are identified by the FLUKE stock number. All listed components are described, and the FLUKE stock number is given. The original MANUFACTURER'S part number for each listed item is given in the Cross Reference List at the rear of this section.

5-4. PARTS LIST COLUMN DESCRIPTIONS

a. The REF DESIG column indexes the item description to the associated illustration. In general the reference designations are listed under each assembly in alpha-numeric order. Subassemblies of minor proportions are sometimes listed with the assembly of which they are a part. In this case, the reference designations may appear out of order.

b. The DESCRIPTION column describes the salient characteristics of the component. Indention of the description indicates the relationship to other assemblies, components, etc. In many cases it is necessary to abbreviate in this column. For abbreviations and symbols used, refer to Appendix B located at the rear of the manual.

c. The six-digit part number, by which the item is identified at the John Fluke Mfg. Co., Inc. is listed in the STOCK NO. column. Use this number when ordering parts from the factory or authorized representatives. In the case where a flag note is used, special ordering is required. Flag note explanations are located as close as possible to the flag note.

d. The TOT QTY column lists the total quantity of the item used in each particular assembly. This quantity reflects only the latest Use Code. Second and subsequent listings of the same item are referenced to the first listing with the abbreviation REF.

e. Entries in the REC QTY column indicate the recommended number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one of each assembly in the instrument be stocked. In

the case of optional subassemblies, plug-ins, etc. that are not always part of the instrument, or are deviations from the basic instrument model, the REC QTY column lists the recommended quantity of the item in that particular assembly.

f. The USE CODE column identifies certain parts which have been added, deleted or modified during the production of the instrument. Each part for which a Use Code has been assigned may be identified with a particular instrument serial number by consulting the Serial Effectivity List, paragraph 5-9. Sometimes when a part is changed, the new part can and should be used as a replacement for the original part.

5-5. MANUFACTURERS' CROSS REFERENCE LIST COLUMN DESCRIPTIONS

a. The six-digit part number, by which the item is identified at the John Fluke Mfg. Co., Inc. is listed in the FLUKE STOCK NO. column. Use this number when ordering parts from the factory or authorized representatives.

b. The Federal Supply Code for the item manufacturer is listed in the MFG column. An abbreviated list of Federal Supply Codes is included in Appendix A.

c. The part number which uniquely identifies the item to the original manufacturer is listed in the MFG PART NO. column. If a component must be ordered by description, the type number is listed.

5-6. HOW TO OBTAIN PARTS

5-7. Standard components have been used whenever possible. Standard components may be ordered directly from the manufacturer by using the manufacturer's part number, or parts may be ordered from the John Fluke Mfg. Co., Inc. factory or authorized representative by using the FLUKE stock number. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

5-8. You can insure prompt and efficient handling of your order to the John Fluke Mfg. Co., Inc. if you include the following information:

a. Quantity.

b. FLUKE Stock Number.

c. Description.

d. Reference Designation.

e. Instrument model and serial number.

Example: 2 each, 215897, Transistor, 2N4126 A2A1Q1 & Q2 for 645A, S/N 123.

If you must order structural parts not listed in the parts list, describe the part as completely as possible. A sketch of the part, showing its location to other parts of the instrument is helpful.

5-9. SERIAL NUMBER EFFECTIVITY

5-10. A Use Code column is provided to identify certain parts that have been added, deleted or modified during production of the Model 4265A. Each part for which a use code has been assigned may be identified with a particular instrument serial number by consulting the Use Code Effectivity List below. All parts with no code are used on all instruments with serial numbers above 123.

USE CODE	SERIAL NUMBER EFFECTIVITY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	BINARY PROGRAMMABLE POWER SOURCE Figure 5-1	4265A			
A1	Mother PCB Assembly (Figure 5-2)	302232	1		
A2	Power Supply PCB Assembly (Figure 5-3)	302307	1		
A3	Pre-Amplifier PCB Assembly (Figure 5-4)	302547	1		
A4	External Reference PCB Assembly (–03 Option) (Figure 5-5)	292581	1		
A5	Binary Ladder PCB Assembly (Figure 5-6)	292524	1		
A6	Isolated Control Logic PCB Assembly (–01 Option) (Figure 5-7)	302539	1		
A6	Direct Coupled Control Logic (–04 Option) (Figure 5-8)	302281	1		
A7	Binary Display PCB Assembly (–02 Option) (Figure 5-9)	302521	1		
A7	No-Display PCB Assembly (–05 Option) (Figure 5-10)	302356	1		
A8	Current Limit PCB Assembly (–06 Option) (Figure 5-11)	302331	1		
A9	Power Ampl. PCB Assembly (Figure 5-6) (Figure 5-12)	302315	1		
A10	Connector PCB Assembly (Figure 5-7) (Figure 5-13)	325068	1		
	Connector, programming, male, 50 contact	307017	1		
	Cover, bottom	308122	1		
	Cover, Top	308072	1		
	Foot	292870	4		
	Line Cord with plug	284174	1		
	Panel, rear	302042	1		
	Panel, front	302034	1		
	Decal, front panel (–02 Option)	312348	1		
	Decal, front panel (–05 Option)	312330	1		
	ACCESSORIES (Not included with the instrument. Order separately).				
	Mating Connector, for programming input lines	266056			
	Rack Mounting Brackets	M04-200-306			
	Manual Control Unit	A4200			

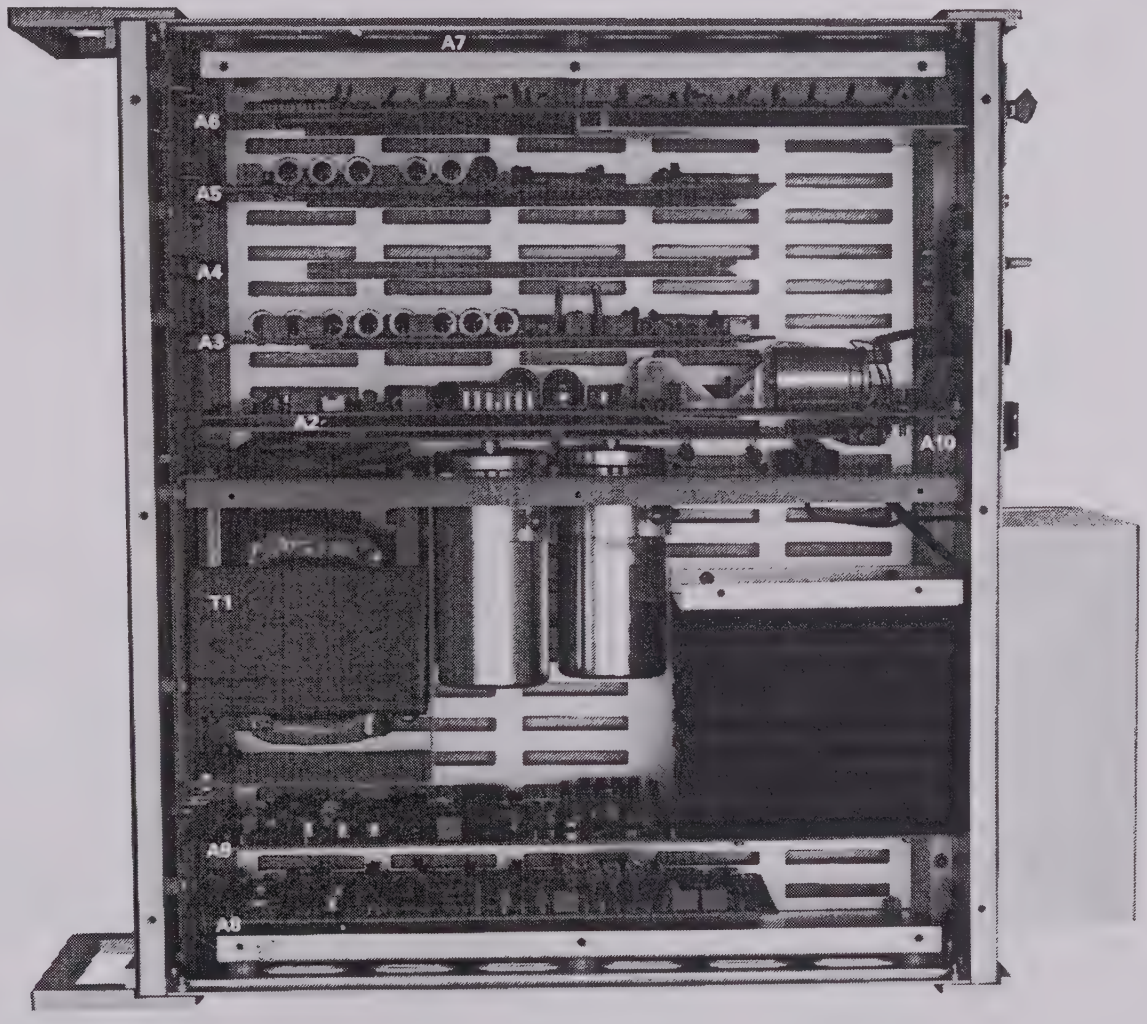


Figure 5-1. MODEL 4265A BINARY PROGRAMMABLE POWER SOURCE

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A1	MOTHER PCB ASSEMBLY Figure 5-2	302232	REF		
J1 thru J7	Connector, female, 50 contact	284604	7		

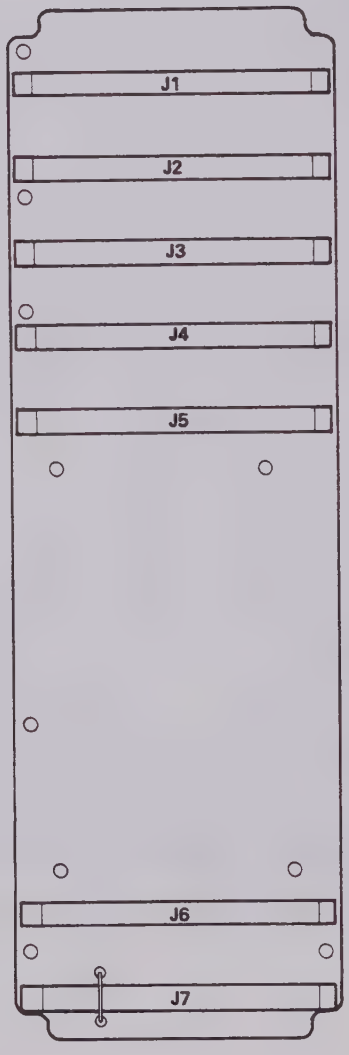


Figure 5-2. MOTHER PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A2	**POWER SUPPLY PCB ASSEMBLY - Figure 5-3**	302307	REF		
C1, C14, C17	Cap, cer, 0.05 uf +80/−20%, 25v	148924	3		
C2, C5, C9, C10, C19,	Cap, mica, 33 pf ±5%, 500v	160317	5		
C3	Cap, mica, 100 pf ±5%, 500v	148494	1		
C4	Not used				
C6	Cap, cer, 500 pf ±10%, 1 kv	105692	1		
C7, C8	Cap, elect, 250 uf +50/−10%, 64v	185850	2		
C11, C12	Cap, elect, 2100 uf +50/−10%, 150v	223172	2		
C13, C16	Cap, elect, 8000 uf +100/−10%, 15v	309245	2		
C15	Not used				
C18	Cap, Ta, 1.0 uf ±20%, 35v	161919	1		
C20	Cap, cer, 2000 pf, gmv, 1 kv	105569	1		
C21	Cap, cer, 0.1 uf +80/−20%, 500v	105684	1		
C22	Cap, plstc, 0.1 uf ±10%, 400v	289744	1		
CR1, CR25, CR26	Diode, silicon, 1 amp, 600 piv	112383	3		
CR2, CR3, CR27 thru CR35	Diode, silicon, 150 ma	203323	11	2	
CR4, CR14, CR19	Diode bridge, 2 amp	296509	3	1	
CR5 thru CR8, CR10 thru CR13, CR15 thru CR18, CR20 thru CR22, CR24	Not used				
CR9, CR23	Diode, zener, 4.3v	180455	2		
F1	Fuse, slow blow, 2 amp, 250v (For 115v operation)	109181	1		
J1	Connector, male, 3 contact, power	284166	1		

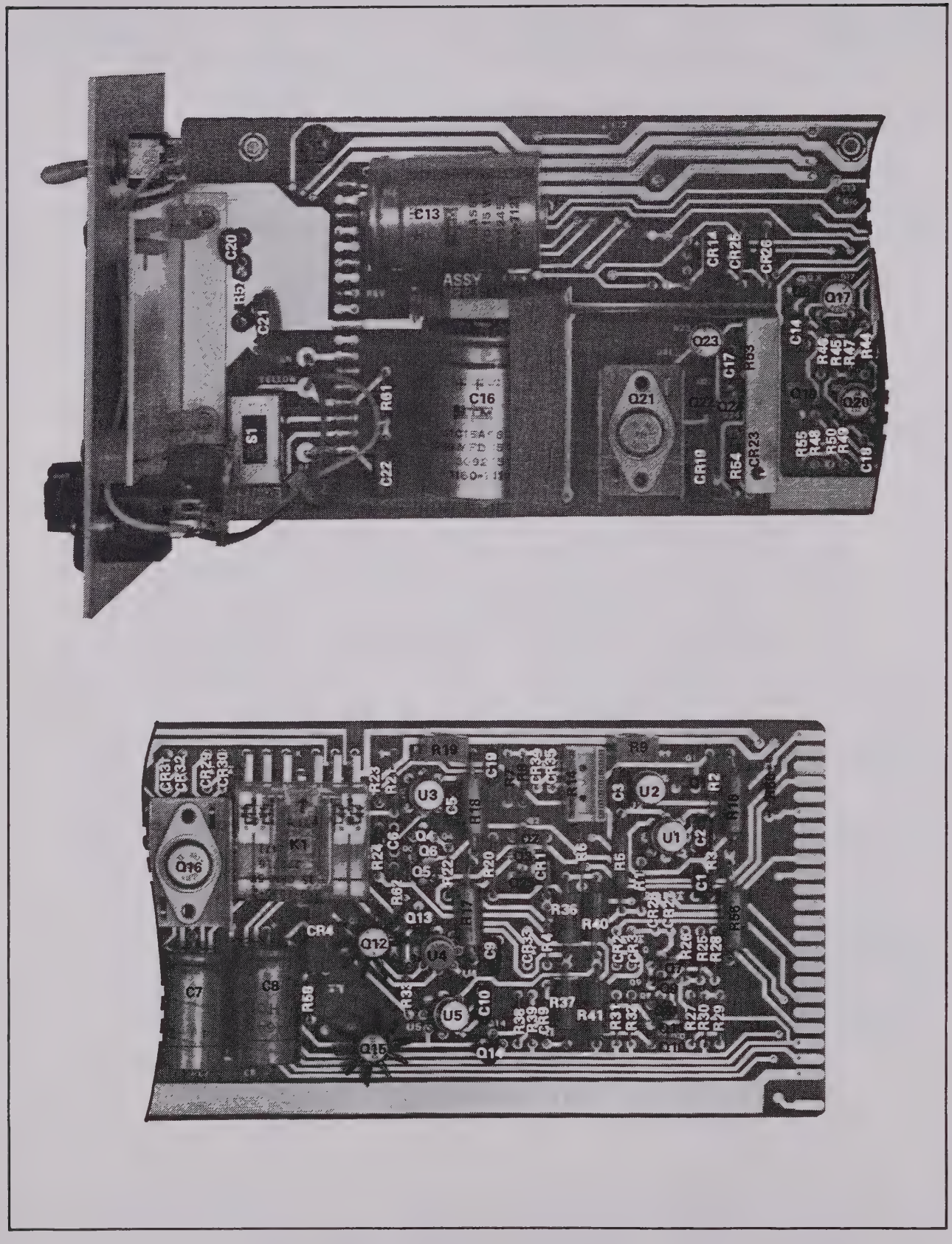


Figure 5-3. POWER SUPPLY PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
J2	Connector, female, 36 contact	285247	1		
K1	Relay, 4PDT, 5v Coil	272716	1	1	
Q1, Q10, Q11, Q13, Q18, Q19, Q24	Tstr, silicon, NPN	218396	7		
Q2, Q3, Q5, Q6	Tstr, J-FET, N-channel	261578	4	2	
Q4, Q7, Q8, Q9, Q14	Tstr, silicon, PNP	195974	5		
Q12, Q17, Q23	Tstr, silicon, NPN	150359	3		
Q15, Q20	Tstr, silicon, PNP	269076	2		
Q16, Q21	Tstr, silicon, NPN	288381	2	1	
Q22	Tstr, J-FET, N-channel	271924	1		
Q25	Tstr, J-FET, N-channel	288324	1	1	
R1, R55	Res, comp, 1k ±5%, 1/4w	148023	2		
R2	Res, met flm, 2.87k ±1%, 1/8w	185629	1		
R3, R46	Res, met flm, 17.4k ±1%, 1/8w	236802	2		
R4	Res, met flm, 5.76k ±1%, 1/8w	260349	1		
R6	Res, met flm, 13.7k ±1%, 1/8w	236752	1		
R7, R8, R22, R24, R28, R30	Res, comp, 22k ±5%, 1/4w	148130	6		
R9	Res, var, cermet, 20Ω ±20%, 1/2w	285114	1		
R10 thru R13	Not used				
R14	Res, met flm, 40.2Ω ±1%, 1/8w	245373	1		
R15	Not used				
R17	Res, ww, 20.02k ±0.1% } Matched Set	291674	1	1	
R18	Res, ww, 20k ±0.1% } Matched Set				
R19	Res, var, cermet, 50Ω ±10%, 1/2w	285122	1		
R20	Res, met flm, 10k ±1%, 1/8w	168260	1		
R21	Res, met flm, 30.1k ±1%, 1/8w	168286	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R23, R44	Res, comp, 10k ±5%, 1/4w	148106	2		
R25, R26, R48	Res, comp, 3.9k ±5%, 1/4w	148064	3		
R27, R29	Res, comp, 2k ±5%, 1/4w	202879	2		
R31, R32, R38	Res, comp, 2.7k ±5%, 1/4w	170720	3		
R33, R39	Res, comp, 4.7Ω 5%, 1/4w	193359	2		
R34, R35	Not used				
R36	Res, ww, 10k ±0.1%, 1/4w	240945	1		
R37, R41	Res, ww, 4.02k ±0.1%, 1/4w	240937	2		
R40	Res, ww, 3.74k ±0.1%, 1/4w	246173	1		
R45, R49, R50, R53, R58, R60	Res, comp, 470Ω ±5%, 1/4w	147983	6		
R47	Res, met flm, 3.74k ±1%, 1/8w	272096	1		
R51, R52	Not used				
R54	Res, comp, 22Ω ±5%, 1/2w	169847	1		
R57,R61	Res, comp, 10Ω ±5%, 1/4w	147868	2		
R59	Res, factory selected value, may not be installed				
R62	Res, met flm, 7.15k ±1%,1/8w	260356	1		
S1	Switch, slide, dpdt, line voltage	234278	1		
S2	Switch, toggle, dpdt, power	115113	1		
T1	Transformer, power (See Figure 5-1)	299602	1		
U1	IC, operational amplifier	271502	1		
U2	IC, reference amplifier				
R5	Res, met flm, selected value } Matched Set	301846	1		
R16	Res, ww, 12k ±0.05%, 1/4w } Matched Set				
R56	Res, ww, 1/4w, selected value } Matched Set				
U3	IC, operational amplifier, selected	225961	1		
U4,U5	IC, operational amplifier	321224	2		
TB1	Terminal barrier strip	295212	1		
XF1	Fuse holder	160846	1		
	Socket, IC, 14 contact	276527	1		
	Heat sink, Q12 & Q15	104646	2		
	Jumper, terminal barrier strip	283713	3		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A3	PRE-AMPLIFIER PCB ASSEMBLY Figure 5-4	302547	REF		
C1, C5	Cap, mica, 1000 pf ±5%, 500v	148387	2		
C2, C6, C12	Cap, mica, 330 pf ±5%, 500v	148445	3		
C3	Not used				
C4	Cap, mica 33 pf ±5%, 500v	160317	1		
C7, C8	Cap, elect, 20 uf +25/−10%, 50v	106229	2		
C9	Cap, elect, 50 uf +50/−10%, 25v	168823	1		
C10	Cap, mica, 3600 pf ±2%, 500v	176644	1		
C11	Cap, mica, 3300 pf ±2%, 500v	192518	1		
C13	Cap, mica, 150 pf ±5%, 500v	148478	1		
C14, C16	Cap, cer, 0.05 ±20%, 100v	149161	2		
C15	Cap, mica, 22 pf ±5%, 500v	148551	1		
CR1, CR2, CR5, CR6	Diode, silicon, 75 ma, 90 piv	260554	4		
CR3, CR4, CR7 thru CR12	Diode, silicon, 150 ma	203323	8		
Q1, Q2, Q3, Q6, Q7, Q10, Q11, Q14, Q15, Q31, Q32	Tstr, FET-SET, N-channel	256487	11		
Q4, Q8, Q12, Q16, Q34, Q37	Tstr, silicon, PNP	195974	6		
Q5, Q9, Q13, Q17, Q19, Q20, Q26, Q33, Q36	Tstr, silicon, NPN	218396	9		
Q18	Tstr, FET, dual, N-channel, selected	225987	1		
Q21, Q22, Q35	Tstr, FET, P-channel	306142	3		
Q23	Tstr, silicon, NPN	159855	1		
Q24, Q25	Tstr, silicon, PNP, dual	242016	2		
Q27, Q28	Tstr, silicon, NPN	269084	2		

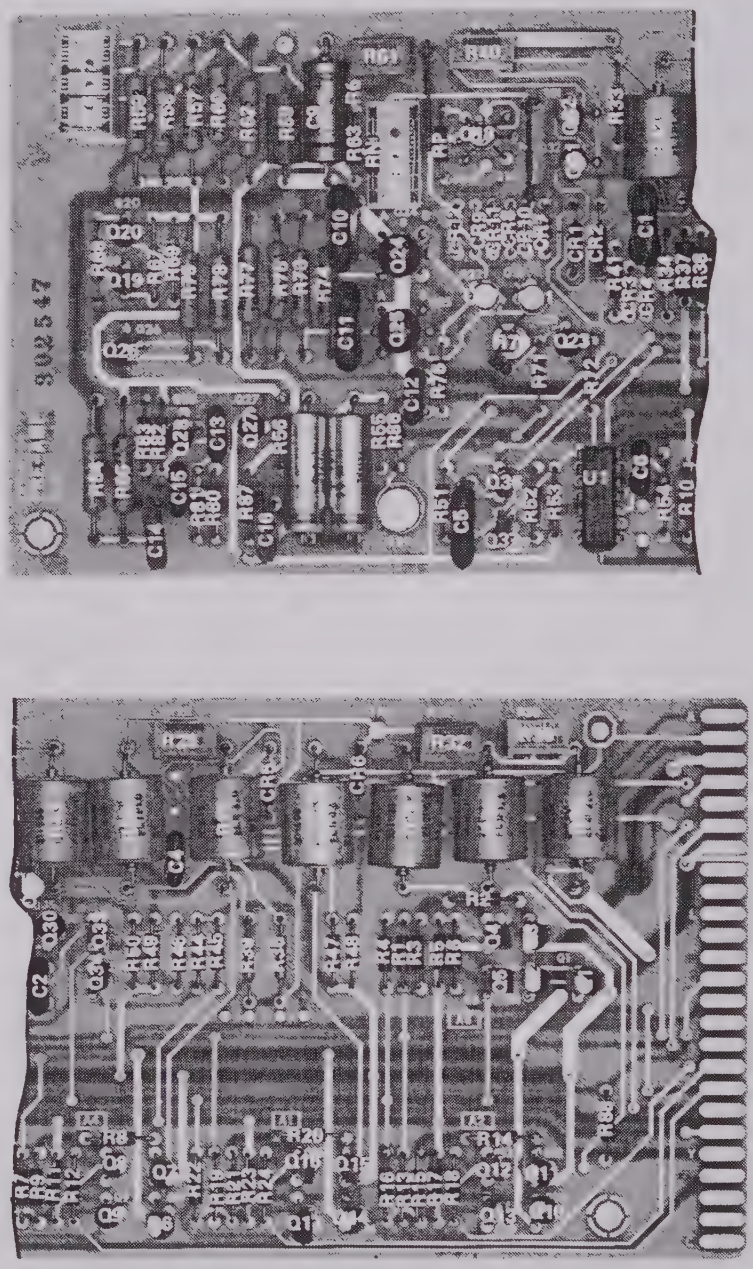


Figure 5-4. MODEL 4265A PRE-AMPLIFIER PCB ASSEMBLY

REF DESIG	DESCRIPTION		STOCK NO	TOT QTY	REC QTY	USE CODE
Q29	Tstr, silicon, NPN		150359	1		
Q30	Tstr, J-FET, N-channel		288324	1		
R1, R3, R7, R9, R13, R15, R19, R21, R38, R41	Res, comp, 51k ±5%, 1/4 w		193334	10		
R2, R8, R14, R20, R47, thru R50, R70	Res, comp, 100k ±5%, 1/4w		148189	9		
R4, R6, R10, R12, R16, R18, R22, R24, R44, R46	Res, comp, 2.7k ±5%, 1/4w		170720	10		
R5, R11, R17, R23	Res, comp, 560 Ω ±5%, 1/4w		147991	4		
R25	Res, ww, 187.6k ±0.1%, 1/2w					
R26	Res, ww, 25.013k ±0.1%, 1/2w					
R27	Res, ww, 50k ±0.1%, 1/2w					
R29	Res, ww, 100.025k ±0.1%, 1/2w	Matched Set	296095	1		
R31	Res, ww, 200 .075k ±0.1%, 1/2w					
R35	Res, ww, 80.08k ±0.1%, 1/2w					
R42, R43	Res, ww, 13.328k ±0.1%, 1/2w					
R28, R40	Res, var, cermet, 50Ω ±5%, 1w		285122	2		
R30	Res, var, cermet, 100Ω ±10%, 1w		285130	1		
R32	Res, var, cermet, 200Ω ±10%, 1w		285148	1		
R33	Res, met flm, 4.02k ±1%, 1/8w		235325	1		
R34	Res, met flm, 12.1k ±1%, 1/8w		234997	1		
R36	Res, met flm, 1.922k ±1%, 1/8w		296343	1		
R37	Res, comp, 100m ±10%, 1/2w		190520	1		
R39	Res, met flm, 641Ω ±1%, 1/8w		296335			
R45	Res, comp, 1k ±5%, 1/4w		148023	1		
R51	Res, comp, 1.5k ±5%, 1/4w		148031	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R52, R53, R83, R86, R88	Res, comp, 5.1k ±5%, 1/4w	193342	5		
R54	Res, met flm, 40.2k ±1%, 1/8w	235333	1		
R55, R56, R63, R87	Res, comp, 10Ω ±5%, 1/4w	147868	1		
R57	Res, met flm, 187k ±1%, 1/8w	296376	1		
R58	Res, met flm, 374k ±1%, 1/2w	262105	1		
R59	Res, met flm, 750k ±1%, 1/2w	155192	1		
R60	Res, met flm, 1.27M ±1%, 1/2w	229252	1		
R61	Res, var, cermet, 100k ±10%, 1w	288308	1		
R62	Res, met flm, 107k 1%, 1/2w	296384	1		
R64, R65	Res, ww, 6.8k ±0.03%, 1/2w	254359	2		
R67, R69	Res, met flm, 2k ±1%, 1/8w	277137	2		
R68	Res, met flm, 10k ±1%, 1/8w	291633	1		
R71	Res, comp, 22k ±5%, 1/4w	148130	1		
R72	Res, comp, 10k ±5%, 1/4w	148106	1		
R73, R75	Res, met flm, 49.9k ±1%, 1/2w	182980	2		
R74	Res, met flm, 2.1k ±1%, 1/2w	193276	1		
R76, R80	Res, comp, 100Ω ±5%, 1/4w	147926	2		
R77, R84	Res, met flm, 10k ±1%, 1/2w	151274	2		
R78, R85	Res, met flm, 4.87k ±1%, 1/2w	247775	2		
R79	Res, met flm, 2.49k ±1%, 1/2w	193995	1		
R81	Res, comp, 910Ω ±5%, 1/4w	203851	1		
R82	Res, comp, 680Ω ±5%, 1/4w	148007	1		
R89	Res, ww, 45Ω ±1%, 1/8w	111815	1		
U1	IC, TTL, Monostable Multivibrator	293050	1		
	Socket, IC, 14 contact	276527	2		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A4	**EXTERNAL REFERENCE PCB ASSEMBLY (−03 OPTION) - Figure 5-5**	292581	REF		
C1, C3	Cap, elect, 20 uf +75/−10%, 50v	106229	2		
C2	Cap, mica, 390 pf ±5%, 500v	148437	1		
C4, C6	Cap, mica, 82 pf ±5%, 500v	148502	2		
C5	Cap, mica, 270 pf ±5%, 500v	148452	1		
C7, C11	Cap, cer, 0.05 uf ±20%, 100v	149161	2		
C8, C9	Cap, mica, 5 pf ±10%, 500v	148577	2		
C10	Cap, mica, 22 pf ± 5%, 500v	148551	1		
CR1 thru CR4	Diode, silicon, 150 ma	203323	4		
Q1	Tstr, J-FET, dual, N-channel, selected	225987	1		
Q2, Q3, Q6, Q12	Tstr, silicon, NPN	218396	4		
Q4, Q5	Tstr, silicon, PNP, dual	242016	2		
Q7, Q8	Tstr, silicon, NPN	269084	2		
Q9, Q10	Tstr, J-FET, N-channel	261578	2		
Q11	Tstr, silicon, PNP	195974	1		
Q13, Q14	Tstr, silicon, NPN	150359	2		
R1	Res, ww, 100.025k } Matched Set	291682	1		
R16	Res, ww, 99.955k } Matched Set				
R2, R11	Res, comp, 10Ω ±5%, 1/4w	147868	2		
R3, R4	Res, ww, 6.8k ±0.03%, 1/2w	254359	2		
R5	Res, met flm, 107k ±1%, 1/2w	296384	1		
R6	Res, var, cermet, 100k ±10%, 1/2w	288308	1		
R7	Res, met flm, 1.27M ±1%, 1/2w	229252	1		
R8	Res, met flm, 750k ±1%, 1/2w	155192	1		
R9	Res, met flm, 374k ±1%, 1/2w	262105	1		
R10	Res, met flm, 187k ±1%, 1/2w	296376	1		
R12	Res, ww, 45Ω ±0.1%, 1/8w	111815	1		
R13, R15	Res, met flm, 2k ±1%, 1/8w	277137	2		

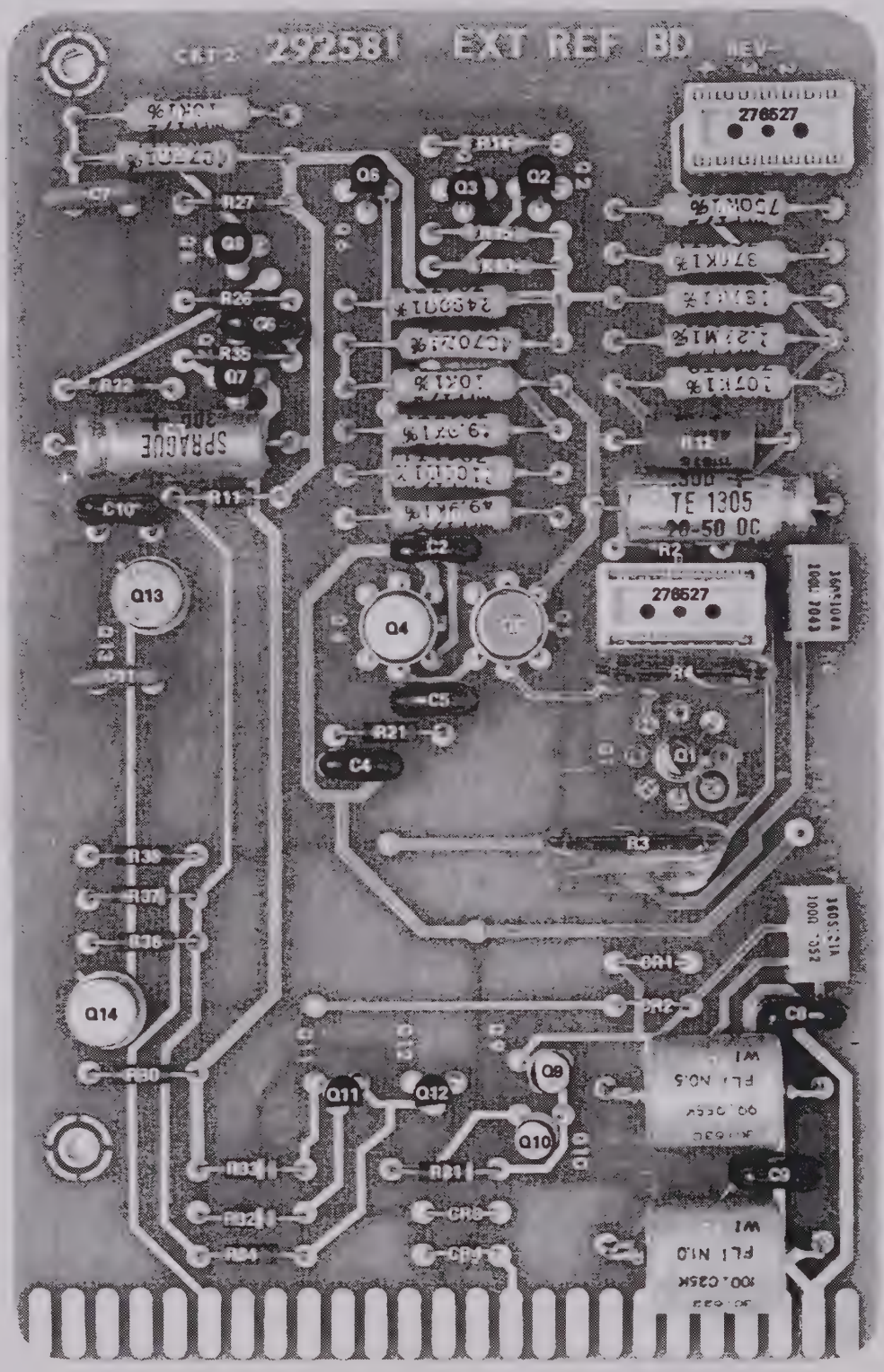


Figure 5-5. EXTERNAL REFERENCE PCB ASSEMBLY (–03 EXTERNAL REFERENCE OPTION)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R14	Res, met flm, 10k ±1%, 1/8w	291633	1		
R17	Res, var, cermet, 100Ω ±10%, 1/2w	285130	1		
R18, R20	Res, met flm, 49.9k ±1%, 1/2w	182980	2		
R19	Res, met flm, 2.1k ±1%, 1/2w	193276	1		
R21, R35	Res, comp, 100Ω ±5%, 1/4w	147926	2		
R22	Res, comp, 5.1k ±5%, 1/4w	193342	1		
R23, R28	Res, met flm, 10k ±1%, 1/2w	151274	2		
R24, R29	Res, met flm, 4.87k ±1%, 1/2w	247775	2		
R25	Res, met flm, 2.49k ±1%, 1/2w	193995	1		
R26	Res, comp, 1k ±5%, 1/4w	148023	1		
R27, R36	Res, comp, 820Ω ±5%, 1/4w	148015	2		
R30	Res, comp, 18k ± 5%, 1/4w	148122	1		
R31	Res, comp, 47k ±5%, 1/4w	148163	1		
R32, R33	Res, comp, 3.9k ±5%, 1/4w	148064	2		
R34	Res, comp, 2.7k ±5%, 1/4w	170720	1		
R37	Res, comp, 4.7k ±5%, 1/4w	148072	1		
R38	Res, comp, 270Ω ±5%, 1/4w	160812	1		
	Socket, IC, 14 contact	276527	2		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A5	**BINARY LADDER PCB ASSEMBLY—Figure 5-6**	292524	REF		
C1, C2	Cap, cer, 0.05 uf ±20%, 100v	149161	2		
CR1	Diode, silicon, 150 ma	203323	1		
Q1	Diode, Field Effect, current regulator	285106	1		
Q2	Tstr, silicon, NPN	168716	1		
Q7,Q11,Q15, Q19,Q23,Q27, Q31,Q35,Q47, Q51	Tstr, silicon, NPN	218396	10	2	
Q3	Tstr, silicon, PNP	269076	1		
Q4,Q37 thru Q44	Not used				
Q5,Q9,Q13, Q17,Q21,Q25 Q29,Q33,Q45 Q49	Tstr, silicon, PNP	195974	10	2	
Q6, Q8	Tstr, J-FET, N-channel, U2366E, Matched Pair	306399	1		
Q10, Q12	Tstr, J-FET, N-channel, U2366E, Matched Pair	306381	1		
Q14,Q16,Q18 Q20	Tstr, J-FET, N-channel, U2366E, Matched Pairs (Q14 matched to Q16; Q18 matched to Q20)	306373	2		
Q22,Q24,Q26 Q28,Q30,Q32 Q34,Q36	Tstr, J-FET, N-channel, U2366E, Matched Set	298307	1		
Q46,Q48,Q50 Q52	Tstr, FET, N-channel	261578	4	1	
R1	Res, var, cermet, 500Ω ±10%, 1w	291120	1		
R2	Res, ww, 24.987k ±0.1%				
R3	Res, ww, 50k ±0.1%				
R5	Res, ww, 100.025k ±0.1% Matched Resistor Set	296111	1		
R6	Res, ww, 200.07k ±0.1%				
R7	Res, ww, 187.6k ±0.1%				
R4,R16, R17,R18,R21, R22,R71 thru R82	Not used				
R8	Res, met flm, 2.94k ±1%, 1/8w	261628	1		

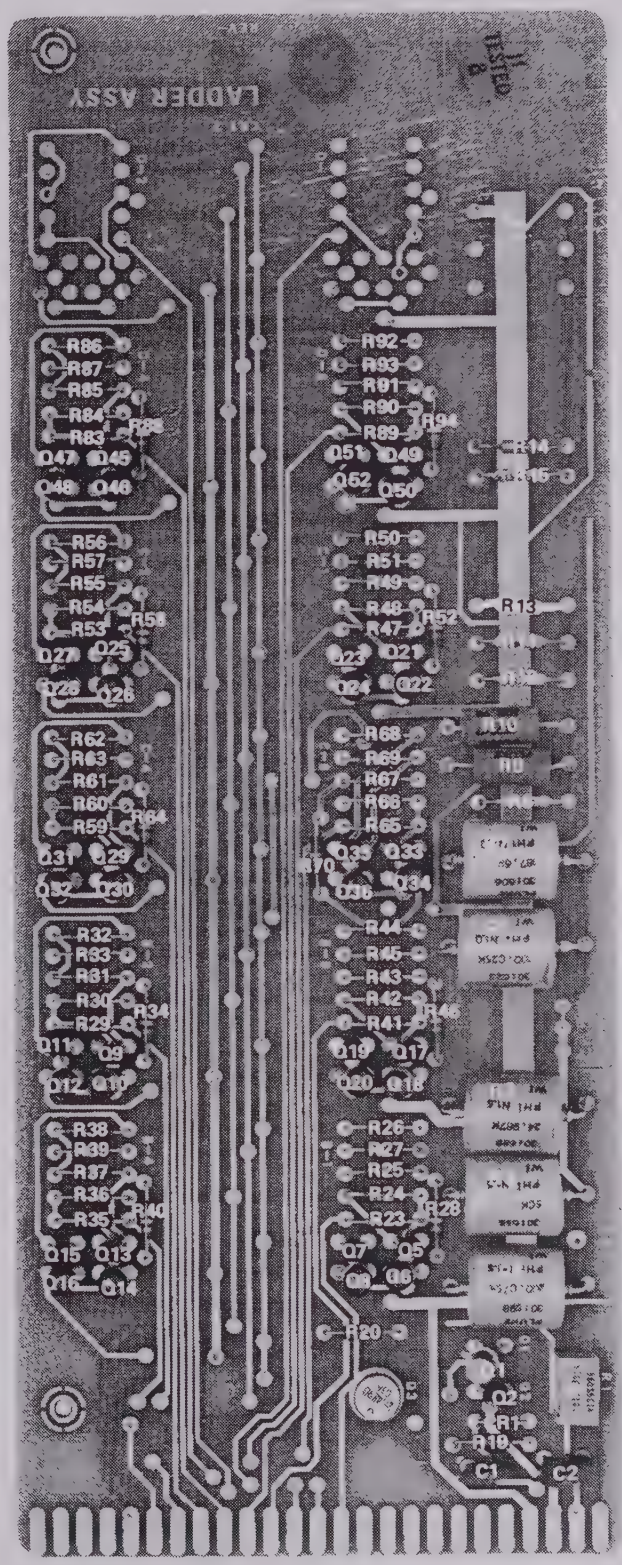


Figure 5-6. BINARY LADDER PCB ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R9	Res, ww, 24.987k ±0.03%, 1/4w	289769	1		
R10	Res, ww, 50k ±0.03%, 1/4w	289777	1		
R11	Res, met flm, 100.03k ±0.1%, 1/8w	291088	1		
R12, R13	Res, met flm, 200.08k ±0.1%, 1/8w	290122	2		
R14	Res, met flm, 200k ±1%, 1/8w	261701	1		
R15	Res, met flm, 100k ±1%, 1/8w	291054	1		
R19	Res, comp, 1.8k ±5%, 1/4w	175042	1		
R24,R30,R36, R42,R48,R54, R60,R66,R84, R90	Res, comp, 560Ω ±5%, 1/4w	147991	10		
R20	Res, comp, 20k ±5%, 1/4w	221614	1		
R25,R27,R28, R31,R33,R34, R37,R39,R40, R43,R45,R46, R49,R51,R52, R55,R57,R58, R61,R63,R64, R67,R69,R70, R85,R87,R88, R91,R93,R94	Res, comp, 51k ±5%, 1/4w	193334	30		
R23,R26,R29, R32,R35,R38, R41,R44,R47, R50,R53,R56, R59,R62,R65, R68,R83,R86, R89,R92	Res, comp, 2.7k ±5%, 1/4w	170720	20		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A6	**LOGIC ASSEMBLY** Figure 5-7	331801	REF		
C1	Cap, plstc. 0.001μf ±10%, 200V	159582	1		
C2, C3	Cap, mica, 12 pf ±5%, 500V	175224	2		
C4, C47	Cap, mica, 100 pf ±1%, 500V	226126	2		
C5	Cap, Ta, 0.68μf ±10%, 35V	182790	1		
C6	Cap, plstc, 3300 pf ±2%, 100V	168344	1		
C7, C8, C9, C29, C50	Cap, mica, 56 pf ±5%, 500V	148528	5		
C10	Cap, mica, 270 pf ±5%, 500V	148452	1		
C11 thru C25, C28, C34 thru C40, C43 thru C46	Cap, cer, 0.025μf ±20%, 50V	168435	27		
C26, C42	Cap, elect, 200μf ±50/−10%, 10V	236935	2		
C27	Cap, cer, 2700 pf gmv, 600V	106211	1		
C30	Cap, mica, 620 pf ±5%, 500V	215244	1		
C31, C49	Cap, mica, 360 pf ±1%, 500V	170407	2		
C32	Cap, mica, 220 pf ±5%, 500V	170423	1		
C33	Cap, plstc, 0.1μf ±10%, 50V	271866	1		
C41	Not used				
C48	Cap, plstc, 0.0075μf ±2%, 100V	168369	1		
CR3, CR4	Diode, high-speed switch	256339	2		
CR5 thru CR9	Diode, Si, 150 mA	203323	5		
Q1, Q3 thru Q15	Xstr, Semicon, Si, NPN	159855	1		
Q2, Q16	Xstr, unijunction, Si	268110	2		
R1	Res, met flm, 523Ω ±1%, 1/8w	294835	1		
R2, R13, R23, R24, R27, R29, R31, R33, R41, R44, R46, R50	Res, comp, 1k ±5%, 1/4w	148023	12		
R3	Res, comp, 2.7Ω ±5%, 1/4w	246744	1		
R4	Res, comp, 1.5k ±5%, 1/4w	148031	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R5, R6, R7	Not used				
R8	Res, met flm, 11.5k ±1%, 1/8w	267138	1		
R9, R54	Res, comp, 100k ±5%, 1/4w	148189	2		
R10, R55	Res, comp, 390k ±5%, 1/4w	193383	2		
R11, R58	Res, comp, 390Ω ±5%, 1/4w	147975	2		
R12	Res, comp, 1.3k ±5%, 1/4w	234252	1		
R14	Res, met flm, 32.4k ±1%, 1/8w	182956	1		
R15	Res, comp, 12k ±5%, 1/4w	159731	1		
R16, R37 thru R40, R42, R60	Res, comp, 200Ω ±5%, 1/4w	193482	7		
R17, R21, R25, R51	Res, comp, 510Ω ±5%, 1/4w	218032	4		
R18, R36, R45, R47, R48, R49, R50	Res, comp, 3.3k ±5%, 1/4w	148056	7		
R19, R20	Res, met flm, 6.98k ±1%, 1/8w	261685	2		
R22, R26, R28, R30, R32, R43	Res, comp, 51Ω ±5%, 1/4w	221879	6		
R34, R52, R56	Res, met flm, 10k ±1%, 1/8w	168260	3		
R35	Not used				
R53	Res, met flm 28k ±1%, 1/8w	291385	1		
R57	Res, comp, 27k ±5%, 1/4w	148148	1		
R61	Res, comp, 5.1k ±5%, 1/4w	193342	1		
T1 thru T6	Xfmr, pulse	299594	6		
U1, U2	IC, TTL, MSI, Eight-Input Multiplexer	326165	2		
U3, U16	IC, TTL, Hex Inverter	293076	2		
U4	IC, TTL, Digital, Multiplexer	288852	1		
U5	IC, TTL, 4-Bit Up-Down Counters	293183	1		
U6, U26	IC, TTL, Hex Inverter	292979	2		
U7	IC, TTL, J-K Flip-Flop	296491	1		
U8, U17	IC, TTL, Dual Retriggerable Monostable Multivibrator	310235	2		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
U9	IC, TTL, Dual 2-Wide 2-Input AND/OR Gate	293084	1		
U10	IC, TTL, J-K Flip-Flop, AND Inputs	293092	1		
U11	IC, TTL, Quad, 2-Input, Pos AND Gates	292987	1		
U12	IC, TTL, Quad, 2-Input Nand Gate	292953	1		
U13, U14	IC, TTL, Dual Peripheral Positive Nand Driver	329706	2		
U15, U18	IC, TTL, Monostable Multivibrator	293050	2		
U19	IC, TTL, Retriggerable Monostable Multivibrator	293134	1		
U20, U21, U22	IC, TTL, 8-Bit Shift Register	272138	3		
U23	IC, TTL, MSI, Dual 4-Bit Latch	293191	1		
	Conn, female, 50 contact	267252	1		

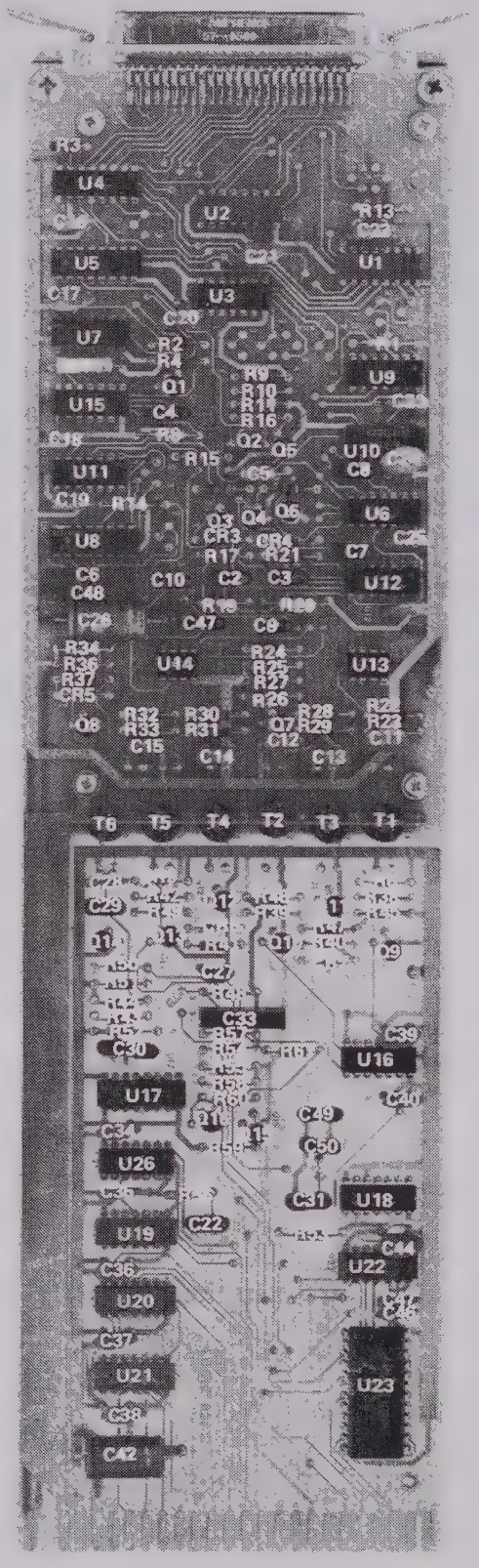


Figure 5-7. ISOLATED CONTROL LOGIC

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A6	**DIRECT COUPLED CONTROL LOGIC (–04 OPTION)** Figure 5-8	302281	REF		
C1	Cap, plstc, .01 uf ±2%, 100v	168385	1		
C2, C3	Cap, elect, 200 uf +50/–10%, 10v	236935	2		
CR1 thru CR26	Diode, zener, 5.6v	277236	26	2	
J1	Connector, female, 50 contact	267252	1		
Q1 thru Q28	Tstr, silicon, NPN	159855	28		
R1	Res, met flm, 32.4k ±1%, 1/8w	182956	1		
R2	Res, comp, 1k ±5%, 1/4w	148023	1		
R3	Res, comp, 390Ω ±5%, 1/4w	147975	1		
R4, R7, R10, R13, R16, R19, R22, R25, R28, R31, R34, R37, R40, R43, R46, R49 R52, R55, R58, R61, R64, R67, R70, R73, R76, R80, R85	Res, comp, 3.3k ±5%, 1/4w	148056	27		
R5, R8, R11, R14, R17, R20, R23, R26, R29, R32, R35, R38, R41, R44, R47, R50, R53, R56, R59, R62, R65, R68, R71, R74, R77, R81, R84	Res, comp, 1.5k ±5%, 1/4w	148031	27		
R6, R9, R12, R15, R18, R21, R24, R27, R30, R33, R36, R39, R42, R45, R48, R51, R54, R57, R60, R63, R66, R69, R72, R75, R78, R82	Res, comp, 470Ω ±5%, 1/4w	147983	26		
R83	Res, comp, 2.7Ω ±5%, 1/4w	246744	1		
U1	IC, TTL, Quad 2-Input NAND Gate	292953	1		
U2	IC, TTL, Hex Inverter	292979	1		
U3	IC, TTL, Retriggerable Monostable Multivibrator	293134	1		

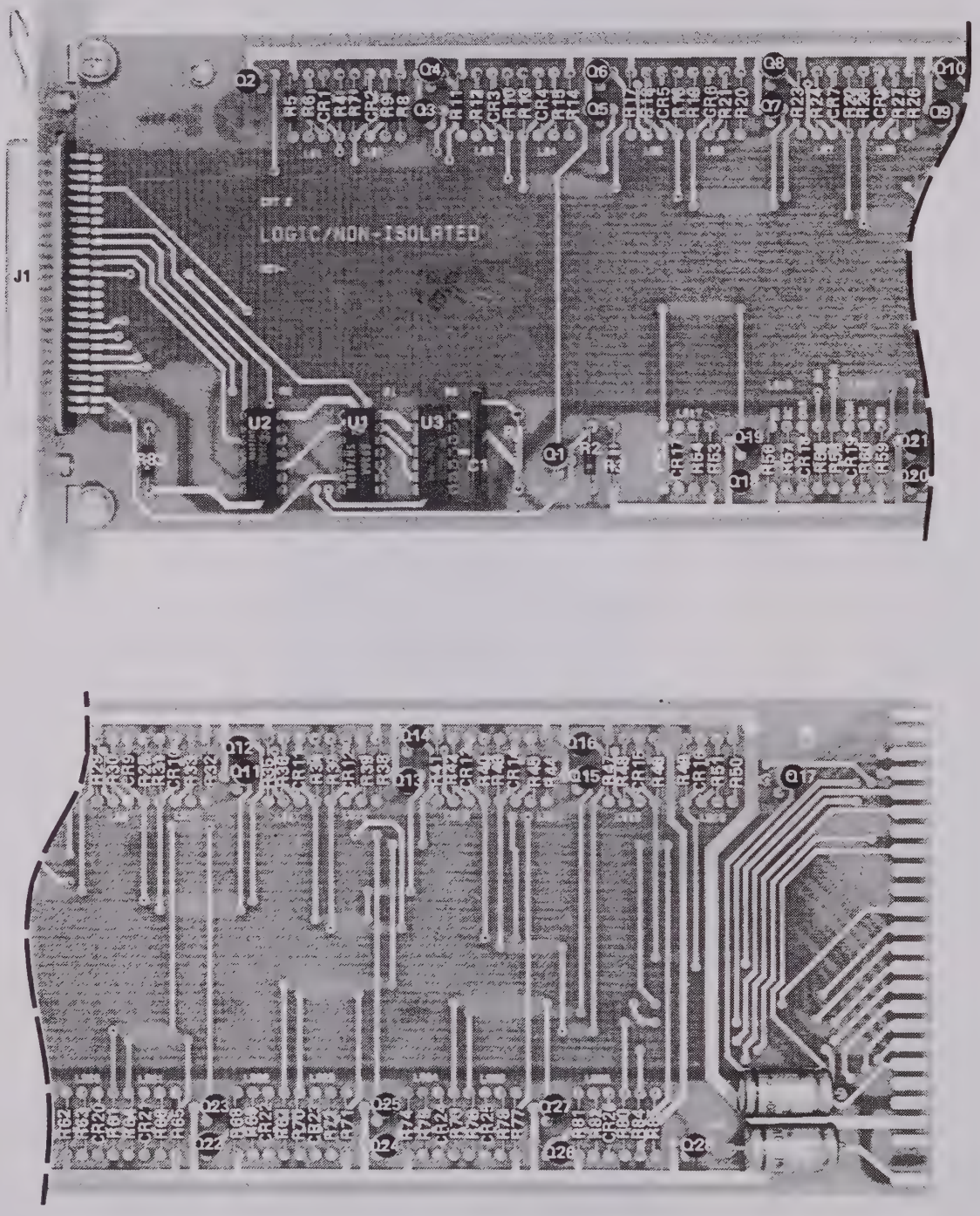


Figure 5-8. NON ISOLATED LOGIC PCB ASSEMBLY (–04 DIRECT COUPLED CONTROL OPTION)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A7	**DISPLAY BCD PCB ASSEMBLY** **Figure 5-8**	302257	REF		
CR1 thru CR27	Diode, light emitting	309617	27		
R1 thru R27	Res, comp, 270Ω ±5%, 1/4w	160804	27		
U1 thru U5	IC, TTL, Hex Inverter	292979	5		

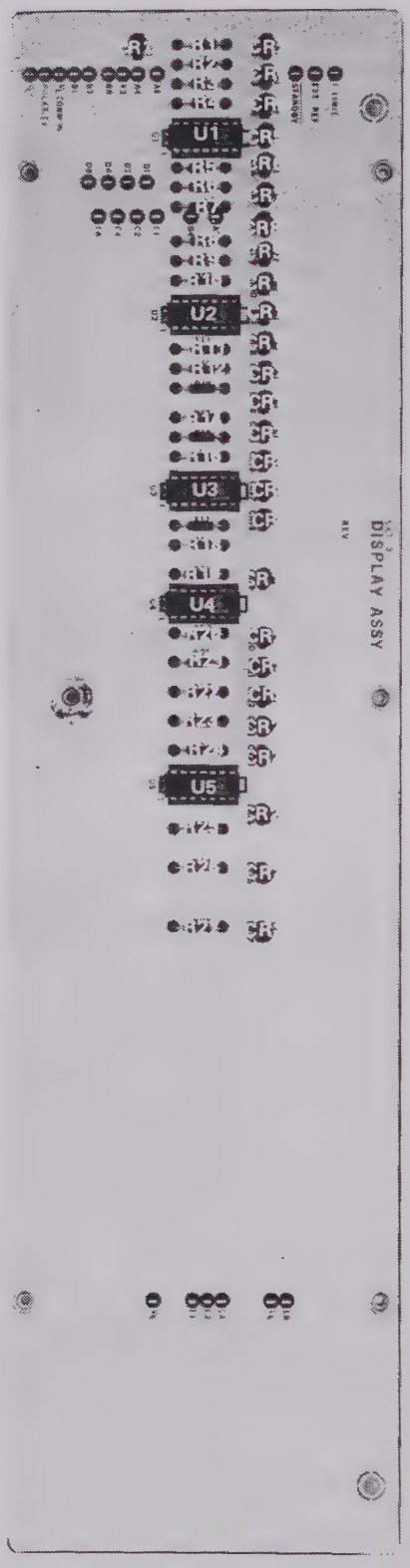


Figure 5-9. BINARY DISPLAY PCB ASSEMBLY (–02 FRONT PANEL DISPLAY OPTION)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A7	NO DISPLAY PCB ASSEMBLY (–05 OPTION) Figure 5-10	302356	REF		
CR1	Diode, light emitting	309617	1		
R1	Res, comp, 270Ω ±5%, 1/4w	160804	1		

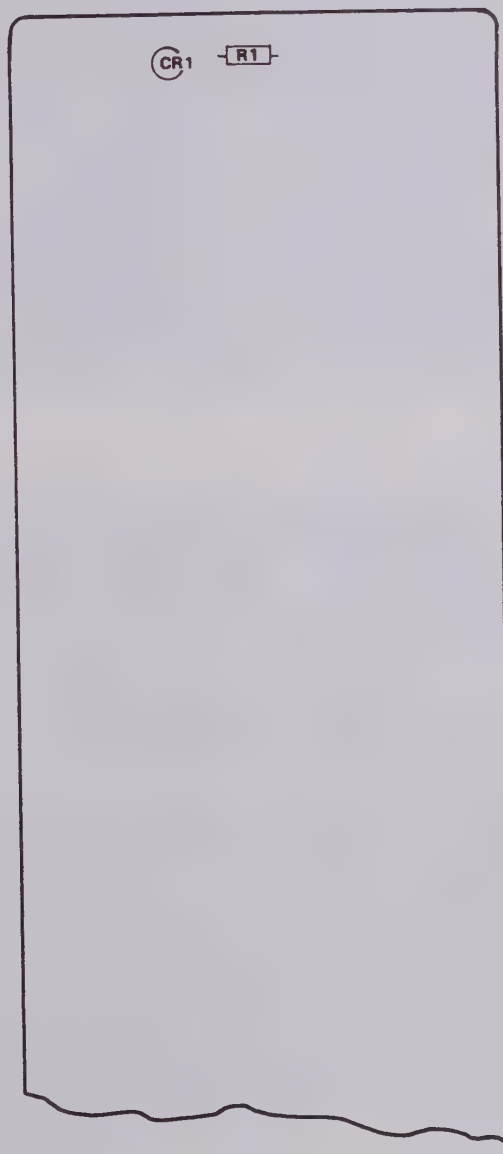


Figure 5-10. NO DISPLAY PCB ASSEMBLY (–05 OPTION)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A8	CURRENT LIMIT PCB ASSEMBLY (–06 Option) Figure 5-11	302331	REF		
C1, C2 C12	Cap, plstc, 0.1 uf ±10%, 250v	161992	3		
C3	Cap, mica, 10 pf ±10%, 500v	175216	1		
C4, C5	Cap, plstc, 0.033 uf ±10%, 100v	106062	2		
C6	Cap, mica, 4 pf ±5%, 500v	190397	1		
C7	Cap, mica, 27 pf ±5%, 500v	177998	1		
C8, C9, C13 thru C16	Cap, cer, 0.0012 uf ±10%, 500v	106732	6		
C10, C11	Cap, mica, 33 pf ±5%, 500v	160317	2		
C17	Cap, plstc, 0.022 uf ±10%, 250v	234484	1		
CR1, CR2	Diode, zener, 16v	113332	2		
CR3, CR5, CR10, CR11	Diode, zener, 3.9v	113316	4		
CR4, CR8	Diode, zener, 8v	246611	2		
CR6, CR9	Diode, zener, 36v	186163	2		
CR7	Diode, zener, 6.3v, 7.5 mA	172148	1		
Q1, Q2, Q5, Q8, Q11, Q14, Q16, Q19, Q20	Tstr, silicon, NPN	218396	9		
Q3, Q7, Q10, Q13, Q15, Q21, Q23	Tstr, silicon, PNP	195974	7		
Q4, Q6, Q9, Q12, Q26	Tstr, J-FET, N-channel	261578	5		
Q17	Tstr, semicon, silicon, PNP, dual	242016	1		
Q18	Tstr, silicon, PNP	276899	1		
Q22	Tstr, silicon, PNP	284448	1		
Q24, Q27, Q28	Tstr, silicon, NPN	218511	3		
Q25	Tstr, silicon, NPN, dual	220087	1		

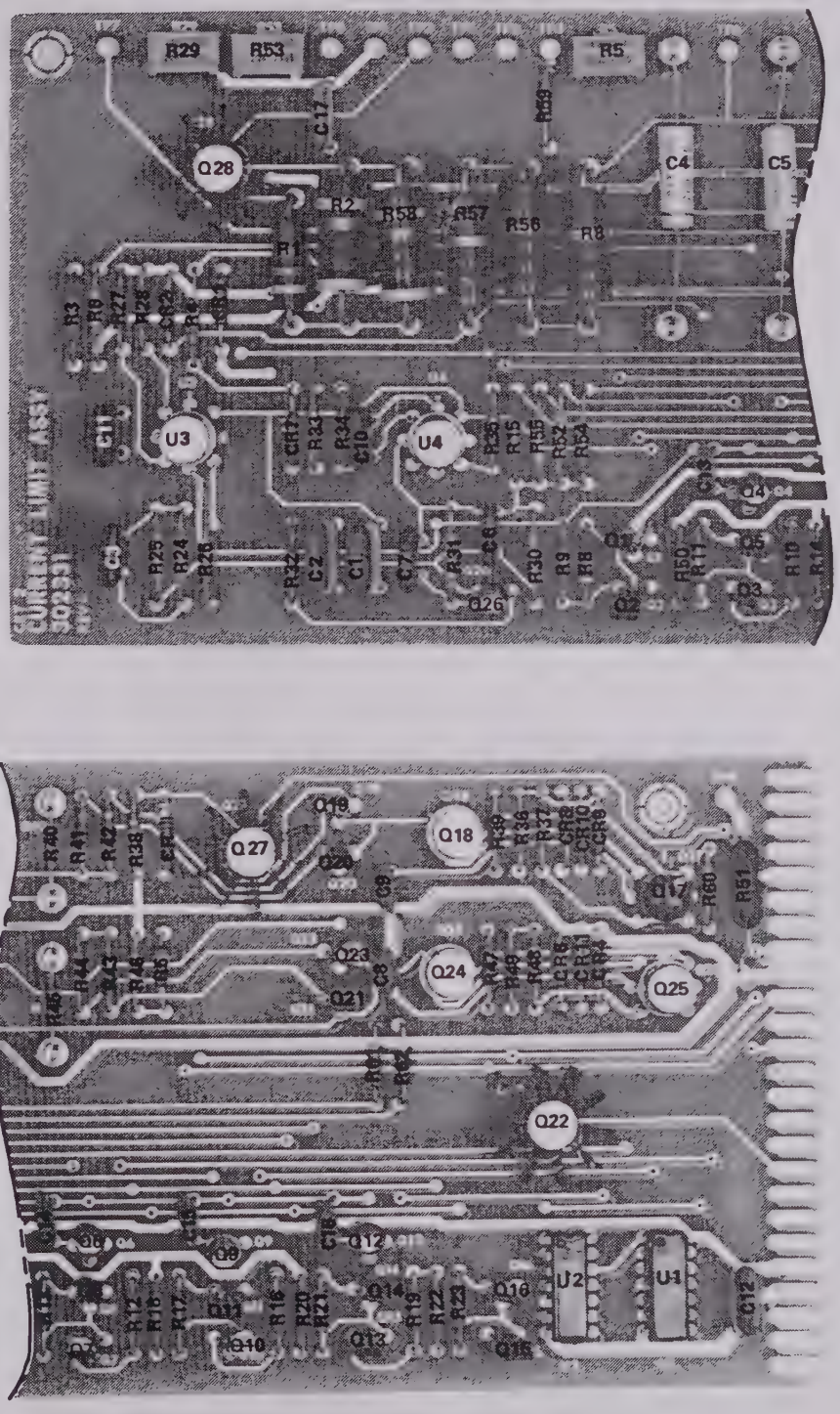


Figure 5-11. CURRENT LIMIT PCB ASSEMBLY (–06 OPTION)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R1	Res, comp, 24k ±5%, 1w	275644	1		
R2, R58	Res, comp, 4.7k ±10%, 2w	245308	2		
R3	Res, met flm, 649Ω ±1%, 1/8w	309955	1		
R4	Res, met flm, 750Ω ±1%, 1/8w	312801	1		
R5	Res, var, cermet, 500Ω ±10%, 1w	291120	1		
R6	Res, met flm, 15Ω ±1%, 1/8w	296434	1		
R7, R56, R57	Res, comp, 1.8k ±10%, 2w	185983	3		
R8	Res, comp, 47k ±5%, 1/4w	148163	1		
R9	Res, comp, 10k ±5%, 1/4w	148106	1		
R10, R12, R16, R19, R22	Res, comp, 24k ±5%, 1/4w	193425	5		
R11, R13, R17, R21, R23, R33	Res, comp, 12k ±5%, 1/4w	159731	6		
R14, R18, R20, R32, R50	Res, comp, 27k ±5%, 1/4w	148148	5		
R15, R54	Res, met flm, 6.19k ±1%, 1/8w	283911	2		
R24, R25	Res, met flm, 10k ±1%, 1/8w	168260	2		
R26, R35	Res, comp, 5.1M ±5%, 1/4w	296467	2		
R27	Res, comp, 5.1k ±5%, 1/4w	193342	1		
R28, R34	Res, comp, 10M±5%, 1/4w	194944	2		
R29, R53	Res, var, cermet, 20k ±10%, 1/2w	291609	2		
R30, R52	Res, met flm, 24.9k ±1%, 1/8w	291369	2		
R31	Res, met flm, 2.74k ±1%, 1/8w	293761	1		
R36, R49	Res, comp, 24K ±5%, 1/2w	108654	2		
R37, R48	Res, comp, 36k ±5%, 1/4w	221929	2		
R38, R46	Res, comp, 39k ±5%, 1/4w	188466	2		
R39, R47	Res, comp, 22k ±5%, 1/4w	148130	2		
R39, R47	Res, comp, 33k ±5%, 1/2w	108761	2		
R40, R45	Res, comp, 120Ω ±5%, 1/4w	170712	2		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R41, R44, R59	Res, comp, 1.2k ±5%, 1/4w	190371	3		
R42, R43	Res, comp, 100Ω ±5%, 1/4w	147926	2		
R51	Res, ww, 1Ω ±1%, 2w	229534	1		
R55	Res, met flm, 12.4k ±1%, 1/8w	261644	1		
R60, R61, R62	Res, comp, 56Ω ±5%, 1/4w	147900			
U1, U2	IC, DTL, Hex Inverter	268367	2		
U3, U4	IC, Operational amplifier	271502	2		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A9	POWER AMPL. PCB ASSEMBLY Figure 5-12	302315	REF		
C1, C4	Cap, mica, 330 pf ±1%, 500v	226142	2		
C2, C3	Cap, mica, 33 pf ±5%, 500v	160317	2		
C5, C9, C10, C16, C22	Cap, mica, 100 pf ±5%, 500v	148494	5		
C6	Cap, mica, 68 pf ±5%, 500v	148510	1		
C7, C15	Cap, elect, 10 uf +50/−10%, 150v	106351	2		
C8	Cap, elect, 125 uf +50/−10%, 16v	186296	1		
C11, C13, C21	Cap, plstc, 0.47 uf ±10%, 250v	184366	3		
C12, C14 C17, C18, C19, C20	Not used				
C23	Cap, mica, 150 pf ±5%, 500v	148478	1		
C24, C25	Cap, plstc, 0.022 uf ±10%, 250v	234484	2		
C26, C27	Cap, cer, 0.01 uf ±20%, 100v	149153	2		
C28, C29	Cap, mica, 10 pf ±10%, 500v	175216	2		
CR1 thru CR10,CR12, CR13,CR19 thru CR22, CR31,CR32, CR35 thru CR37	Diode, silicon, 150 mA	203323	21		
CR11, CR17	Not used				
CR14,CR16, CR24,CR25, CR27 thru CR30,CR33, CR34,CR38, CR39	Diode, silicon, 1 amp, 600 piv	112383	12		
CR18	Diode, zener, 36v	237354	1		
CR23, CR26	Diode, zener, 36v	186163	2		
P1 thru P8	Connector, receptacle	267633	8		
Q1	Tstr, silicon, PNP	266619	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
Q2, Q3, Q4, Q8, Q11, Q13, Q18, Q20 thru Q26, Q29, Q38	Tstr, silicon, NPN	218511	16		
Q5, Q6, Q7, Q9, Q10, Q12, Q14, Q17, Q30, Q36	Tstr, silicon, PNP	284448	10		
Q15, Q27, Q28, Q35	Tstr, silicon, PNP	195974	4		
Q16, Q19, Q34, Q39, Q40	Tstr, silicon, NPN	218396	5		
Q31	Tstr, silicon, NPN	190710	1		
Q32, Q33, Q41, Q42	Tstr, silicon, NPN, power, (on heat sink)	313213	4		
Q37	Tstr, silicon, PNP, power	309302	1		
R1, R2, R9, R10, R23	Res, comp, 2k ±5%, 1/4w	202879	5		
R3, R8, R69, R73	Res, comp, 20k ±5%, 1/4w	221614	4		
R4, R6	Res, comp, 62k ±5%, 1/4w	220053	2		
R5, R7	Res, comp, 270Ω ±5%, 1/4w	160804	2		
R11	Res, met flm, 1.21k ±1%, 1/8w	229146	1		
R12, R26, R65, R67	Res, comp, 1k ±5%, 1/4w	148023	4		
R13, R31, R40	Res, comp, 100Ω ±5%, 1/4w	147926	3		
R14, R18	Res, comp, 240k ±5%, 1/4w	218016	2		
R15, R19, R63	Res, comp, 330k ±5%, 1/4w	192948	3		
R16, R17	Res, comp, 6.2k ±5%, 1/4w	221911	2		
R20, R22	Res, comp, 10k ±5%, 1/4w	148106	2		
R21	Res, met flm, 10k ±1%, 1/8w	168260	1		
R24	Res, met flm, 6.04k ±1%, 1/8w	285189	1		
R25	Res, met flm, 30.1k ±1%, 1/8w	168286	1		
R27	Res, comp, 1.8k ±5%, 1w	180331	1		

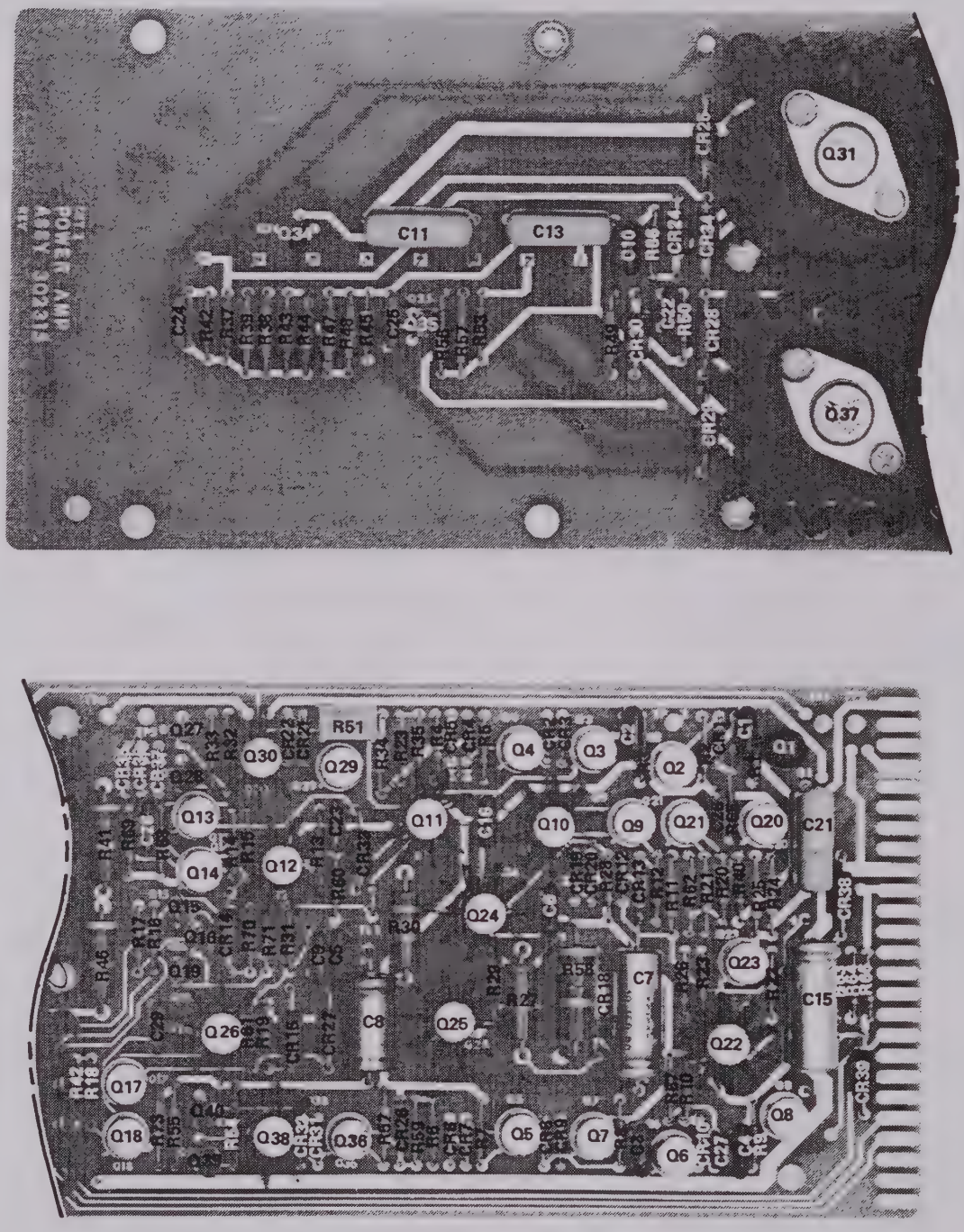


Figure 5-12. POWER AMPLIFIER PCB ASSEMBLY (Sheet 1 of 2)

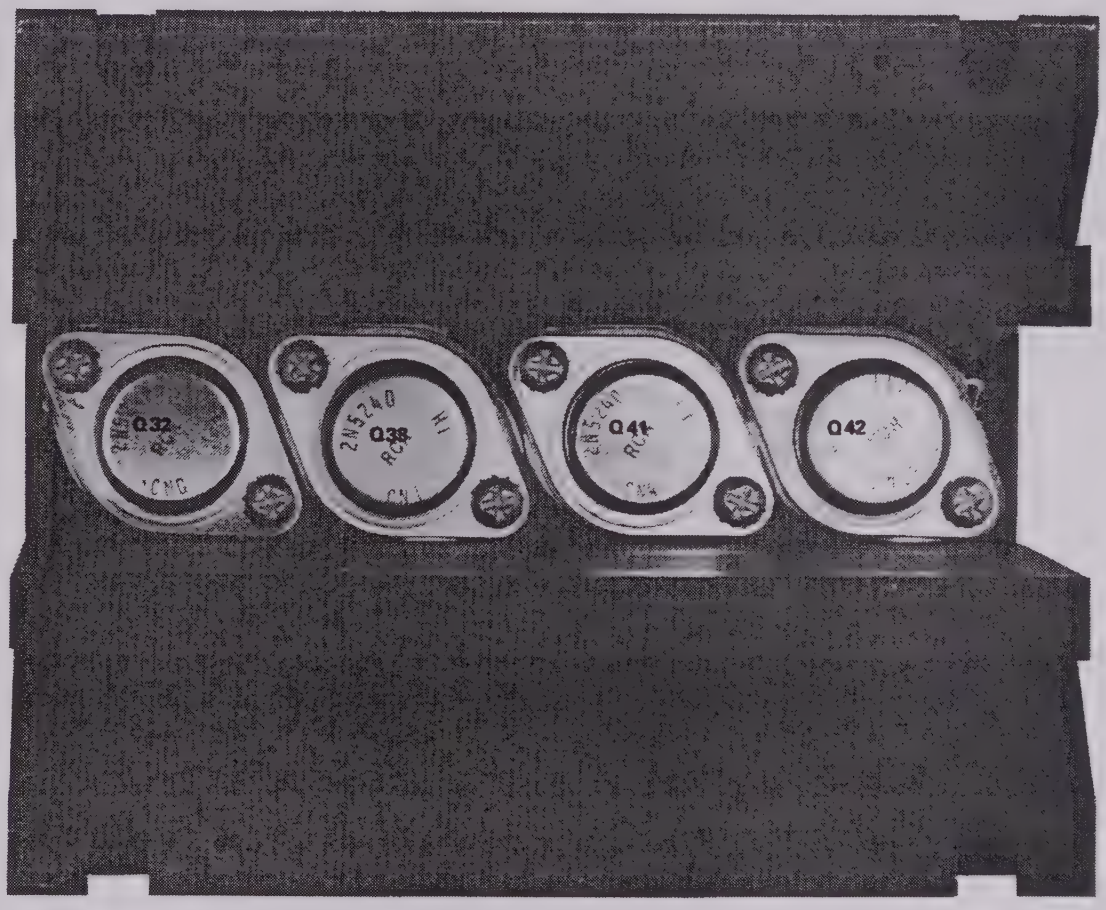


Figure 5-12. POWER AMPLIFIER PCB ASSEMBLY (Sheet 2 of 2)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
R28, R29	Res, comp, 180Ω ±5%,1/4w	147942	2		
R30	Res, comp, 13k ±5%, 1w	309641	1		
R32, R55	Res, met flm, 549Ω ±1%, 1/8w	289272	2		
R33, R54	Res, met flm, 100Ω ±1%, 1/8w	168195	2		
R34, R52	Res, met flm, 32.4k ±1%, 1/8w	182956	2		
R35, R59	Res, comp, 15k ±5%, 1/4w	148114	2		
R36, R50, R60, R61, R68, R70, R71, R72	Res, comp, 100k ±5%, 1/4w	148189	8		
R37, R53	Res, comp, 68Ω ±5%, 1/4w	147918	2		
R38, R39, R56, R57	Res, comp, 1Ω ±5%, 1/2w	218693	4		
R41, R46	Res, comp, 4.7k ±10%, 1w	109587	2		
R42, R45	Res, comp, 36Ω ±5%, 1/4w	312843	2		
R43, R44, R47, R48	Res, comp, 1.1Ω ±5%, 1/4w	163717	4		
R49	Res, comp, 51Ω ±5%, 1/2w	144717	1		
R51	Res, var, cermet 100Ω ±10%, 1w	285130	1		
R58	Res, comp, 3.3k ±5%, 2w	218859	1		
R62	Res, met flm, 40.2k ±1%, 1/8w	235333	1		
R64, R66	Res, comp, 1M ±5%, 1/4w	182204	2		
	Connector, receptacle	267617	8		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A10	CONNECTOR PCB ASSEMBLY	325068	REF		
CR1 thru CR4	Diode, silicon, 1 amp, 600 piv	112383	4		
R1, R2	Res, comp, 15k ±10%, 2w	110080	2		

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
A4200	89536	A4200
104646	05820	NF207
105569	71590	PA140-139CB
105684	56289	41C92
105692	71590	2DDH60N501K
106062	56289	33392
106229	56289	30D206G05CC4
106351	56289	30D397F150DD4
106674	56289	C023B102G332M
106732	71590	CF-122
108654	01121	EB2425
108761	01121	EB3325
109181	71400	TYPE MDX
109587	01121	GB4721
110080	01121	HB1531
111815	01686	TYPE R1250
112383	05277	IN4822
113316	07910	IN748
113332	07910	IN966A
115113	95146	MST215N
144717	01121	EB5105
147868	01121	CB1005
147900	01121	CB5605
147918	01121	CB6805
147926	01121	CB1015
147942	01121	CB1825
147975	01121	CB3915
147983	01121	CB4715
147991	01121	CB5615
148007	01121	CB6815
148015	01121	CB8215
148023	01121	CB1025
148031	01121	CB1525
148056	01121	CB3325
148064	01121	CB3925
148072	01121	CB4725
148106	01121	CB1035
148114	01121	CB1535
148122	01121	CB1835
148130	01121	CB2235
148148	01121	CB2735
148163	01121	CB4735
148189	01121	CB1045
148387	14655	CD19F101J
148437	14655	CD15F391J
148445	14655	CD15F151J
148452	14655	CD15F271J
148478	14655	CD15F330J
148494	14655	CD15F101J
148502	14655	CD15F820J
148510	14655	CD15F680J
148528	14655	CD15F560J
148551	14655	CD15E220J
148577	14655	CD15C050K
148924	72982	5855-Y50-503Z
149153	56289	C023B101F103M
149161	56289	55C23A1
150359	95303	2N3053
151274	91637	TYPE MFF1/2
155192	91637	TYPE MFF1/2
159731	01121	CB1235
159855	07910	CS23030
160317	14655	CD15E330J
160804	01121	CB2715
160812	01121	CB2705
160846	75915	342004
161919	56289	196D105X0035
161992	73445	C280AE/A100K

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.	FLUKE STOCK NO.	MFR.	MFR. PART NO.
163717	01121	EB11G5	190371	01121	CB1225
168195	91637	TYPE MFF1/8	190397	14655	CD15C040K
168260	91637	TYPE MFF1/8	190520	01121	EB1071
168286	91637	TYPE MFF1/8	190710	04713	2N3739
168385	84171	PE103G	192518	14655	CD19F330G
168435	56289	C128B101H253M	192948	01121	CB3355
168716	07263	S19254	193276	91637	TYPE MFF1/2
168823	25403	C426ARF50			
169847	01121	EB2205	193334	01121	CB5135
170423	14655	CD15F221J	193342	01121	CB5152
170712	01121	CB1215	193359	01121	CB47G5
170720	01121	CB2725	193425	01121	CB2435
172148	03877	IN3496	193482	01121	CB2015
175042	01121	CB1825	193995	91637	TYPE MFF1/2
175216	01121	CD15C100K	194944	01121	CB1065
175224	14655	CD15E120J	195974	04713	2N3906
176644	14655	CD19F360G	202879	01121	CB2025
177980	14655	CD15F431J	203323	03508	DHD1105
177998	14655	CD15F270J			
180331	01121	GB1825	203851	01121	CB9115
180406	07910	IN758	203869	01121	CB4315
180455	07910	IN749A	218016	01121	CB2445
182204	01121	CB1055	218032	01121	CB5115
182790	56289	150D684X9035A2	218396	04713	2N3904
182956	91637	TYPE MFF1/8	218511	95303	60994
182980	91637	TYPE MFF1/8	218693	01121	EB10G5
184366	73445	C280AE/A470K	218859	01121	HB3325
185239	91637	TYPE MFF1/8	220053	01121	CB6235
185850	73445	C437ARH250	220087	GE	12E1516
185983	01121	HB1821	221614	01121	CB2035
186163	07910	IN974B	221861	01121	CB1105
186296	73445	C426ARE125	221911	01121	CB6225
188466	01121	CB3935	221929	01121	CB3635

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
223172	56289	36D212F150BC2B
225961	89536	225961
225987	89536	225987
226142	14655	CD15F331F
226159	14655	CD19F681F500
229146	91637	TYPE MFF1/8
229252	91637	TYPE MFF1/2
229534	91637	TYPE RS-2C
234252	01121	CB1325
234278	82389	XW1649
234484	73445	C280AE/A22K
234997	91637	TYPE MFF1/8
235325	91637	TYPE MFF1/8
235333	91637	TYPE MFF1/8
235366	91637	TYPE MFF1/8
236752	91637	TYPE MFF1/8
236802	91637	TYPE MFF1/8
236885	13511	225-21821-105
236935	73445	C426ARD200
237008	14655	CD19F221J
237354	04713	IN3033
240937	89536	240937
240945	89536	240945
242016	07263	SE4901
245308	01121	HB4721
245373	91637	TYPE MFF1/8
246173	89536	246173
246611	07910	TYPE 1N961B
246744	01121	CB27G5
247775	91637	TYPE MFF1/2
254359	89536	254359
256339	28480	5082-2900
256487	89536	256487
260349	91637	TYPE MFF1/8
260356	91637	TYPE MFF1/8
260554	07910	CD55105
261578	15818	U2366E
261610	91637	TYPE MFF1/8
261628	91637	TYPE MFF 1/8
261644	91637	TYPE MFF1/8
261685	91637	TYPE MFF1/8
261701	91637	TYPE MFF1/8
262105	91637	TYPE MFF1/2
266056	02660	57-30500
266197	01121	CB1625
266619	07263	2N4888
267252	02660	57-40500
267617	00779	85863-5
267633	00779	86144-1
268110	03508	2N6027
268367	04713	MC836P
269076	95303	2N4037
269084	07910	CS2484
271502	12040	LM301A
271866	06001	75F2R5A104
271924	07910	CFE13041
272096	91637	TYPE MFF1/8
272138	12040	DM8570
272716	24796	R40-E030-1
275644	01121	GB2435
276527	23880	TSA-2900-14W
276899	95303	2N5415
277137	91637	TYPE MFF1/8
277202	14655	CD15E430F
277236	07910	1N752A
283713	71285	422-13-11-013
283911	91637	TYPE MFF1/8
284166	82839	EAC301

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
284174	70903	KHS-7041
284448	95303	2N5416
284604	02660	225-22521-110
285106	07910	CRE3021
285114	71450	360S-200B
285122	71450	360S-500A
285130	71450	360S-101A
285148	71450	360S-201A
285189	91637	TYPE MFF1/8
285247	02660	225-21821-103MOD
288308	71450	360S-104A
288324	15818	U1994E
288381	95303	40372
288480	91637	TYPE MFF1/8
288845	01295	SN7402N
289272	91637	TYPE MFF1/8
289744	73445	C280CF/A100K
289769	89536	289769
289777	89536	289777
289827	89536	289827
290106	91637	TYPE MFF1/8
290114	91637	TYPE MFF1/8
290122	91637	TYPE MFF1/8
291054	91637	TYPE MFF1/8
291062	91637	TYPE MFF1/8
291070	91637	TYPE MFF1/8
291088	91637	TYPE MFF1/8
291120	71450	360S-501A
291369	91637	TYPE MFF1/8
291609	71450	360S-203A
291633	91637	TYPE MFF1/8
291674	89536	291674
291682	89536	291682
292524	89536	292524
292581	89536	292581
292870	89536	292870
292953	01295	SN7400N
292979	01295	SN7404N
292995	01295	SN7410N
293050	01295	SN74121N
293068	01295	SN74H00N
293076	01295	SN74H04N
293084	01295	SN74H51N
293092	01295	SN74H102N
293134	07263	U6A960159X
293183	01295	SN7472N
293191	04713	MC8308P
293209	07263	U6B930959X
293761	91637	TYPE MFF1/8
295212	71785	TYPE 140Y
296095	89536	296095
296111	89536	296111
296335	91637	Type MFF1/8
296343	91637	Type MFF1/8
296376	91637	TYPE MFF1/2
296384	91637	TYPE MFF1/2
296434	91637	TYPE MFF1/8
296467	01121	CB5175
296491	01295	SN7472N
296509	09423	FB100
298307	89536	298307
299594	89536	299594
299602	89536	299602
301846	89536	301846
302034	89536	302034
302042	89536	302042
302232	89536	302232
302273	89536	302273
302281	89536	302281

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.	FLUKE STOCK NO.	MFR.	MFR. PART NO.
302307	89536	302307			
302315	89536	302315			
302331	89536	302331			
302349	89536	302349			
302356	89536	302356			
302521	89536	302521			
302539	89536	302539			
302547	89536	302547			
304410	89536	304410			
304485	89536	304485			
304808	89536	304808			
306142	05397	3N173			
306373	89536	306373			
306381	89536	306381			
306399	89536	306399			
307017	02660	57-30500-3			
308072	89536	308072			
308122	89536	308122			
309245	99392	61C15AS83			
309302	04713	2N5345			
309617	71318	FLV102			
309641	01121	GB1325			
309955	91637	TYPEMFF1/8			
312330	89536	312330			
312348	89536	312348			
312801	91637	TYPEMFF1/8			
312843	01121	CB3615			
313213	95303	2N5240			
321224	34333	SG8178T			
325068	89536	325068			

Section 6

Option & Accessory Information

6-1. INTRODUCTION

6-2. This section of the manual contains information pertaining to the accessories and options available for your instrument.

6-3. OPTION INFORMATION

6-4. Each of the options available for this instrument, if any, are described separately under headings containing the option number. The option descriptions contain applicable operating and maintenance instructions and field installation procedures. A complete list of replaceable parts for each option is contained at the end of that option description.

6-5. ACCESSORY INFORMATION

6-6. The accessory information, if applicable, will contain details concerning accessories that may be used with this particular instrument.

Option -09
Multi-Strobe Isolated Logic

609-1. INTRODUCTION

609-2. Multi-Strobe Isolated Logic, Option -09 for the Fluke 4200 Series Programmable Voltage Sources, provides voltage source remote control capability. A computer, a system controller or the Fluke Automatic Test Equipment System can control Programmable Voltage Sources equipped with the Multi-Strobe Isolated Logic Option.

609-3. The 4200-09 Option comprises two printed circuit boards mounted as one assembly within a 4200 Series Voltage Source. Physical access to the 4200-09 is through an opening in the 4200 chassis rear panel; electrical access is through a 50-pin connector.

609-4. Program source to 4200-09 connection is through a cable from the selected program source to the 4200-09 50-pin connector. (Refer to Figure 609-1.) The interconnecting cable connector is an Amphenol Blue Ribbon 57-30500, Fluke Stock Number 266056. The program source cable connector and cable wiring configuration is determined by the program source in use. An additional 56-pin card edge connector on the 4200-09 rear panel provides single program source control of up to eight 4200-09 units. Additional 4200-09 units are connected in a series configuration as shown in Figure 609-2.

609-5. Program Source Requirements

609-6. Fluke 4200 Series Programmable Voltage Sources require either BCD or Binary coded input commands; the 4200-09 Option will operate with either coding format. Source program data must include the following information:

1. Output voltage magnitude.
2. Output voltage range.
3. Output voltage polarity.
4. Current limit magnitude and range. (Option).
5. Strobe pulse(s).
6. Voltage Source mainframe address.
7. Operate Standby signal.
8. External Internal Reference Signal. (Option).

609-7. In addition to providing program information to the voltage source, the program source should be capable of receiving status information from the voltage source. Through unique voltage source mainframe address, the program source can determine the status of any voltage source in a multiple source system. Status information supplied by the voltage source includes:

1. Current Limit condition (Polled).
2. Power Off condition (Polled).
3. Abnormal Status.
4. Ready/Not Ready Status.

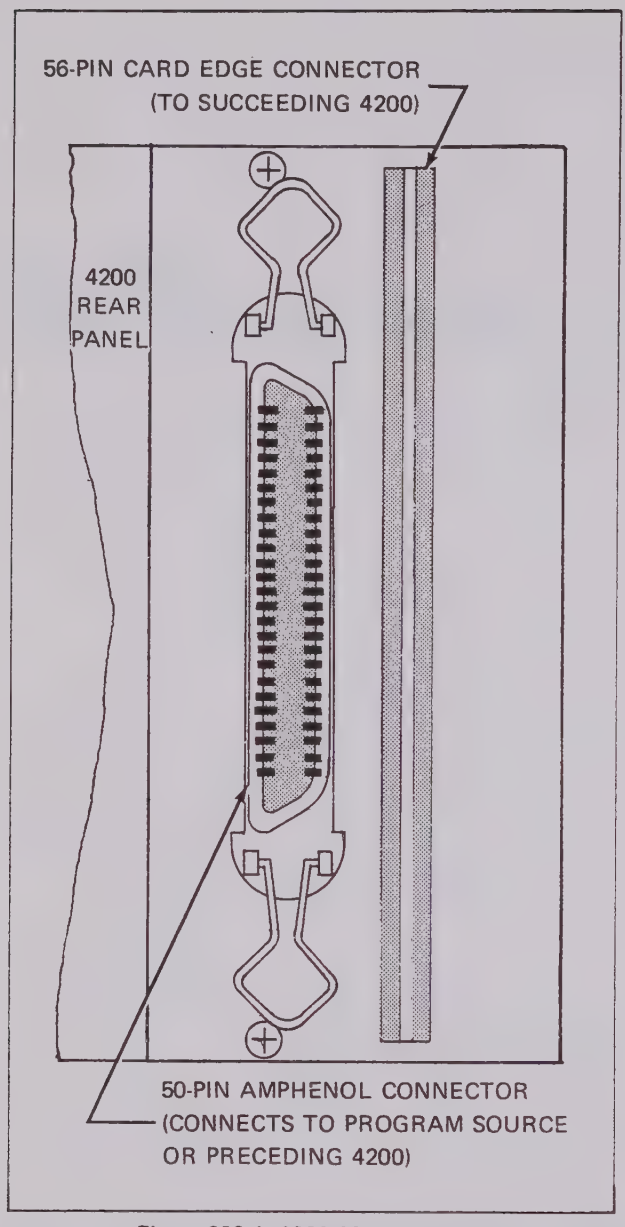


Figure 609-1. 4200-09 Connectors

609-8. OPERATING INSTRUCTIONS

609-9. Since a program source, not a human operator, controls the 4200-09 Multi-Strobe Isolated Logic, the following operating instructions define program data required for 4200-09 operation. Table 609-1 describes standard interface signals between the 4200-09 and a Binary format program source; Table 609-2, describes standard interface signals between the 4200-09 and a BCD format program source. Some program data variations are possible through jumper connection options to tailor the 4200-09 for operation with a specific program source. (Refer to Table 609-3 for Standard Jumper Assignments.)

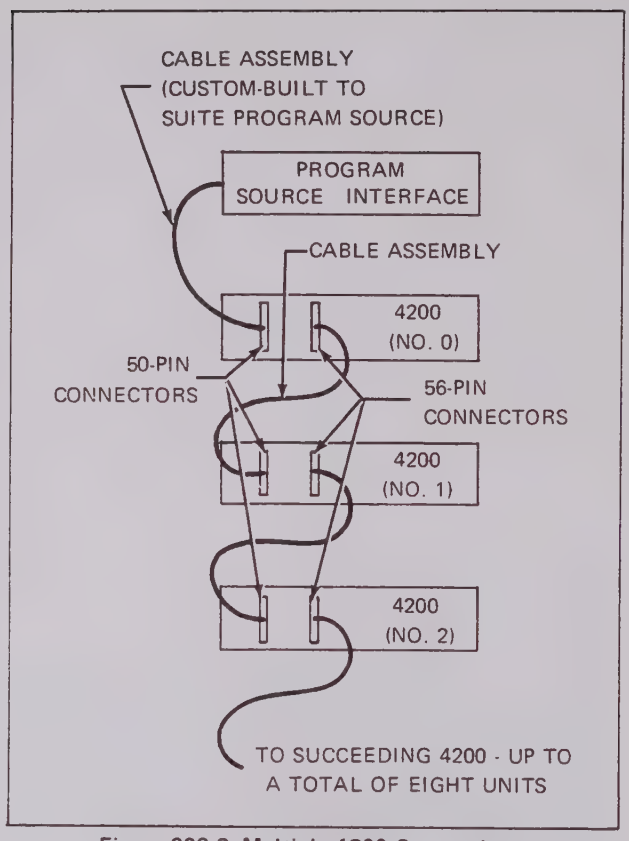


Figure 609-2. Multiple 4200 Connections

609-10. BINARY PROGRAM OPERATION

609-11. Binary Format

609-12. The standard Binary program data format for 4200-09 Voltage Sources consists of a 16-bit data word and a 16-bit control word. Refer to Figure 609-3. The control word can be less than 16-bits if less than eight voltage sources are programmed from one program source, or if the External Reference or Current Limit Options are not installed. Other Binary data formats are possible, but they require changing 4200-09 pcb jumper connections.

609-13. The first 14-bits of a 16-bit Binary data word contain voltage magnitude programming. The 15th bit is strobe control; the 16th bit is polarity programming. The first control word bit is standby/operate, and the second control word bit is output range programming. If the voltage source is equipped for external reference and selectable current limiting, six control word bits are required for those functions. The third control word bit would select the external reference mode; the fourth bit would select the current limit range. The remaining four bits would determine current limit magnitude. Eight remaining control word bits are address lines, used to select one voltage source in a multiple source system for programming.

Table 609-1. Input/Output Signals, Binary Program Source

PIN NUMBER		SIGNAL NAME	DESCRIPTION (Logic 1 = 2.4V to 5.0V; Logic 0 = 0 to 0.4V)
50-PIN CONN.	56-PIN CONN.		
42, 19, 44, 43, 24, 25 8, 38, 10, 11, 40, 39, 14 & 12	P, R, S, T, K, L, M, N, E, F, H, J, A, B	Voltage output magnitude	Fourteen lines used to program the output voltage with a binary word. The least significant bit (pins 12 and B) is 2^{0}; the most significant bit (pins 42 and P) is 2^{13}. (Logic 1 = bit true; Logic 0 = bit false.)
13	D	Strobe Control	Single line used to steer the control strobe signal to transfer either the control word portion of the program data or the data portion of the program data. (Refer also to Single Strobe Operation.) Logic 1 transfers the control word; Logic 0 transfers the data word.
26	$\overline{C}$	Polarity (Sign)	Single line to program output polarity. Logic 1 for negative output; Logic 0 for positive output.
1	27	Output magnitude range	Single line to program output magnitude range on those voltage sources requiring range selection. (Logic 1 = high range; Logic 0 = low range.)
31	$\overline{E}$	External reference	Single line to program external reference mode on those voltage sources equipped with the external reference option. (Logic 1 = ext. reference; Logic 0 = int. reference.)
2	28	Current limit range	Single line to program range of current output limiting on those voltage sources equipped current limit selection. (Logic 1 = 1 amp range; Logic 0 = 100 mA range.)
37, 35, 5 & 3	4, 3, 2, & 1	Current limit magnitude	Four lines to select the current limit value, expressed as a percentage of the programmed ranges. Up to 120% can be programmed. Any attempt to program 0% results in 10%. (Logic 1 = bit true; Logic 0 = bit false.)
17	U	Standby/Operate (address zero)	Single line used to select the standby or operate mode of the voltage source. Logic 1 programs Standby; Logic 0 programs operate.
23, 22, 34, 32, 7, 6, 4	V, W, X, Y, Z, $\overline{A}$,	Standby/Operate (addresses one through seven)	Seven lines (through connections) used to select the standby or operate mode of up to seven succeeding voltage sources.
20	12	Instrument mainframe (address zero)	Single line used to address the voltage source in order to perform any programming function. The addressing signal must be present in order for any strobe signal to be recognized by the 4200-09 logic. Logic 1 is address true; Logic 0 is address false.

Table 609-2. Input/Output Signals, Binary Program Source (cont)

PIN NUMBER		SIGNAL NAME	DESCRIPTION (Logic 1 = 2.4 to 5V; Logic 0 = 0 to .4V)
50-PIN CONN.	56-PIN CONN.		
21 & 45 thru 50	6 thru 11	Instrument mainframe address one through seven	Seven lines (through connections) used to address up to seven succeeding voltage sources.
18	13	Control Word Strobe	Single line which accepts a Logic 1, 1 μs or longer, pulse to load the control word or data word, depending on the state of the strobe control line. (See Sheet 1, pins D & 13.)
9	15	Poll status	Single line used to poll status (Vcc failure and current limit mode). A Logic 0 causes the generation of Vcc and current limit status at their respective outputs.
29	22	Polled current limit flag	Single line which generates a Logic 0 when the polled 4200 is in the current limit mode.
28	21	Polled power-off flag	Single line which generates a Logic 0 when the Vcc supply of the polled 4200 fails (power off).
27	23	Abnormal status	Single line which generates a Logic 0 whenever a 4200 goes to the current limit mode or the Vcc supply fails (power off). This status line does not need to be polled.
30	24	Vcc	Single line which provides Vcc to the staus logic on the 4200-09. (This is necessary in order to obtain polled power-off status when power is off.) Current requirement is 2 mA per power source.
16	25	Ready flag	Single line which provides a Logic 0 for a fixed time period after receipt of a strobe signal. The time period is equal to worst case settling time after the voltage source is programmed to a new output level.
			NOTE *Current Limit, Power Off, Abnormal Status and Ready Flags require program source pull up resistors to reach Logic 1 state.*

Table 609-2. Input/Output Signals, BCD Program Source

PIN NUMBER		SIGNAL NAME	DESCRIPTION (Logic 1 = 0 to 0.4V; Logic 0 = 2.4 to 5V)
50-PIN CONN.	56-PIN CONN.		
43, 44, 19 & 42	T, S, R & P	Voltage output magnitude — MDS	Four BCD lines to program the most significant digit of the output voltage. (All 16 Magnitude Bits - Logic 1 = bit true; Logic 0 = bit false.)
38, 8, 25 & 24	N, M, L & K	Voltage output magnitude — 2SD	Four BCD lines to program the second most significant digit of the output voltage.
39, 40, 11 & 10	J, H, F & E	Voltage output magnitude — 3SD	Four BCD lines to program the third most significant digit of the output voltage.
13, 15 12 & 14	D, C, B & A	Voltage output magnitude — LSD	Four BCD lines to program the least significant digit of the output voltage.
26	$\overline{C}$	Polarity (Sign)	Single line to program output polarity. Logic 1 programs negative output; Logic 0 programs positive output.
1	27	Output Magnitude range	Single line to program output magnitude range on those voltage sources requiring range selection. (Logic 1 = high range; Logic 0 = low range.)
31	$\overline{E}$	External reference	Single line to program external reference mode on those voltage sources equipped with the external reference option. (Logic 1 = ext. reference; Logic 0 = int. reference.)
2	28	Current limit range	Single line to program range of current output limiting on those voltage sources equipped current limit selection. (Logic 1 = 1 amp range; Logic 0 = 100 mA range.)
37, 35, 5 & 3	4, 3 2 & 1	Current limit magnitude	Four lines to select the current limit value, expressed as a percentage of the programmed range. Up to 120% can be programmed. Any attempt to program 0% results in 10%. (Logic 1 = bit true; Logic 0 = bit false.)
17	U	Standby/Operate (address zero)	Single line used to select the standby or operate mode of the voltage source. Logic 1 programs standby; Logic 0 programs operate.
23, 22, 34, 32, 7, 6, & 4	V, W, X, Y, Z, $\overline{A}$,	Standby/Operate (addresses one through seven)	Seven lines (through connections) used to select the standby or operate mode of up to seven succeeding voltage sources.
20	12	Instrument mainframe (address zero)	Single line used to address the voltage source in order to perform any programming function. The addressing signal must be present in order for any strobe signal to be recognized by the 4200-09 logic. Addressing is by a Logic 1 on address line zero. Refer also to Addressing Multiple Mainframes.

Table 609-2. Input/Output Signals, BCD Program Source (cont)

PIN NUMBER		SIGNAL NAME	DESCRIPTION
50-PIN CONN.	56-PIN CONN.		
21 & 45 thru 50	6 thru 11	Instrument mainframe addresses one through seven	Seven lines (through connections) used to address up to seven succeeding voltage sources.
18	13	Control word strobe	Single line which accepts a Logic 1, 1 μs or longer, pulse to load the control word portion of the program data into the 4200-09 assembly. (Refer also to Dual-Strobe Operation.)
36	14	Data word strobe	Single line which accepts a Logic 1, 1 μs or longer, pulse to load the data word portion of the program data into the 4200-09 assembly. (Refer also to Dual-Strobe Operation.)
9	15	Poll status	Single line used to poll status (Vcc failure and current limit mode). A Logic 1 causes the generation of Vcc and current limit status of their respective outputs.
29	22	Polled current limit flag	Single line which generates a Logic 1 when the polled 4200 is in the current limit mode.
28	21	Polled power-off	Single line which generates a Logic 1 when the Vcc supply of the polled 4200 fails (power off).
27	23	Abnormal status	Single line which generates a Logic 1 whenever the 4200 goes to the current limit mode or the Vcc supply fails (power off). This status line does not need to be polled.
30	24	Vcc	Single line which provides Vcc to the status logic on the 4200-09. (This is necessary in order to obtain polled power-off status when power is off.) Current requirement is two milliamperes per power source.
16	25	Ready flag	Single line which provides a Logic 1 for a fixed time period after receipt of a strobe signal. The time period is equal to worst case settling time after the source is programmed to a new output level.

Table 609-3. Standard Jumper Configurations

4210A 4250A 4270A	4216A 4265A 4275A	4210A 4250A 4270A	4216A 4265A 4275A	4210A 4250A 4270A	4216A 4265A 4275A
B to E	A to B	V to W	W to Y	6 to 7	2 to 4
C to D	C to E	$\overline{A}$ to $\overline{B}$	$\overline{A}$ to $\overline{B}$	9 to 10	5 to 7
F to H	G to H	$\overline{E}$ to $\overline{F}$	$\overline{E}$ to $\overline{F}$	11 to 13	8 to 10
J to K	J to L	$\overline{G}$ to $\overline{H}$	$\overline{G}$ to $\overline{H}$	14 to 15	11 to 12
L to M	K to M	$\overline{L}$ to $\overline{M}$	$\overline{L}$ to $\overline{M}$	16 to 17	14 to 17
N to P	N to R	25 to 26	F to 27	18 to 20	16 to 19
S to T	T to U	1 to 4	26 to 28	22 to 23	

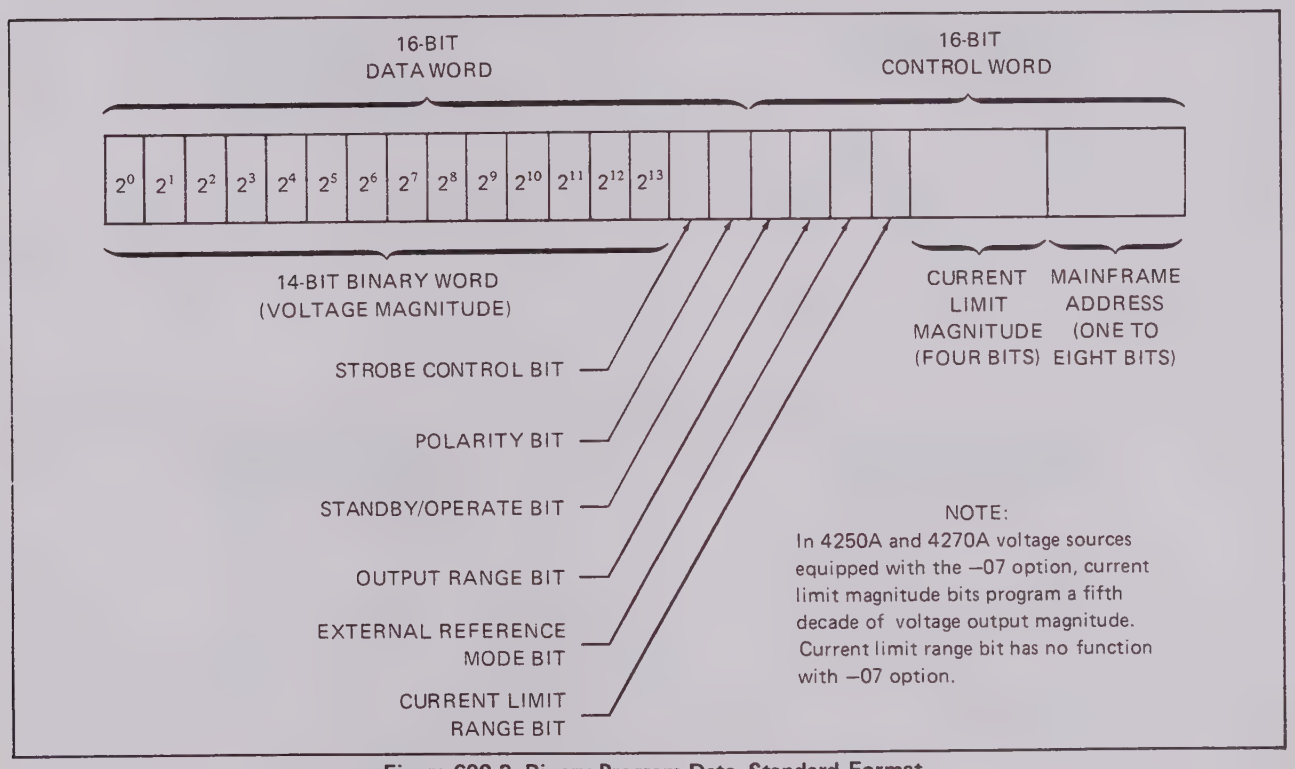

16-BIT DATA WORD
16-BIT CONTROL WORD
2^0 2^1 2^2 2^3 2^4 2^5 2^6 2^7 2^8 2^9 2^{10} 2^{11} 2^{12} 2^{13}
14-BIT BINARY WORD (VOLTAGE MAGNITUDE)
CURRENT LIMIT MAGNITUDE (FOUR BITS)
MAINFRAME ADDRESS (ONE TO EIGHT BITS)
STROBE CONTROL BIT
POLARITY BIT
STANDBY/OPERATE BIT
OUTPUT RANGE BIT
EXTERNAL REFERENCE MODE BIT
CURRENT LIMIT RANGE BIT
NOTE:
In 4250A and 4270A voltage sources equipped with the –07 option, current limit magnitude bits program a fifth decade of voltage output magnitude. Current limit range bit has no function with –07 option.

Figure 609-3. Binary Program Data, Standard Format

609-14. BINARY LOGIC SENSE

609-15. Data word logic sense, positive-true (true = 5V) or negative-true (true = 0V), is determined by jumper connections between pads J, K, L, M, W, X, and Y. Standard operation uses positive-true logic, and it is achieved through jumpering W to Y, J to L, and M to K. Negative-true data word logic may be established by jumpering W to X, J to K, and M to L (refer to Figure 609-4).

609-16. Control word logic sense may also be either positive-true or negative-true, with positive-true being the standard operating logic sense. To establish positive-true control word logic, jumper pad N to pad R; to establish negative-true logic, jumper pad N to pad P. (Refer to Figure 609-4.)

609-17. BINARY VOLTAGE SOURCE POLARITY

609-18. Voltage source output polarity, either positive or negative, is selected by a polarity bit in the 16-bit Binary data word. Bit-16 in the data word is polarity selection (refer to Figure 609-3). It is possible to establish polarity using the first bit of the control word by jumpering pad 16 to pad 17 and pad B to pad E. However, if the first control word bit is used for polarity, asynchronous standby/operate programming must be established by jumpering pad 20 to either pad 19 (standby = positive-true) or pad 18 (operate = positive-true). Pad D must be jumpered to pad C for either logic sense. (Refer to Figure 609-4.)

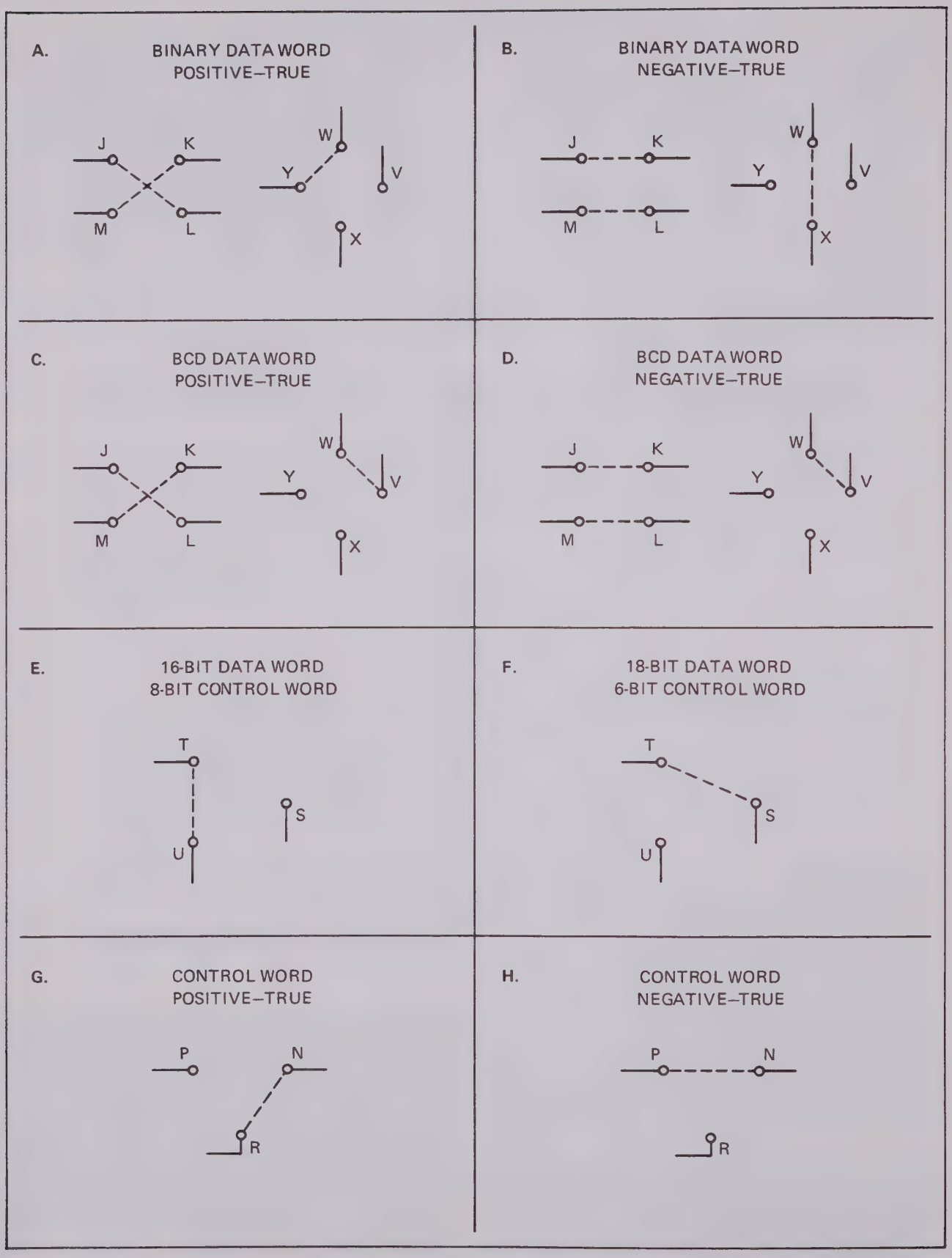
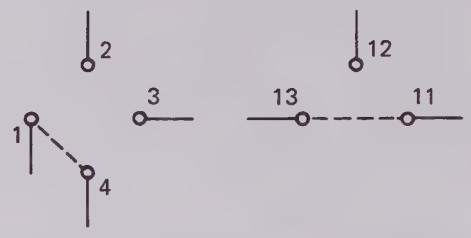
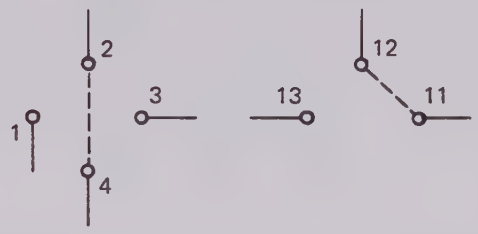


Figure 609-4. 4200-09 Jumper Connections

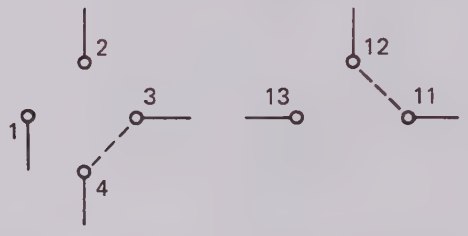
J. BCD/BINARY DUAL STROBE



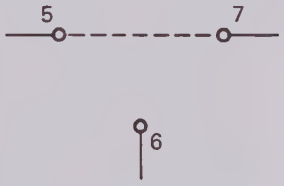
K. BINARY SINGLE STROBE;
STROBE CONTROL POSITIVE–TRUE
TO LOAD CONTROL WORD



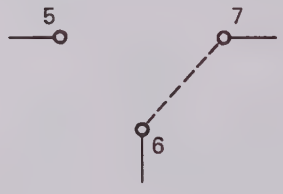
L. BINARY SINGLE STROBE;
STROBE CONTROL POSITIVE–TRUE
TO LOAD DATA WORD



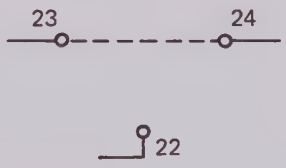
M. CONTROL WORD STROBE BIT
POSITIVE–TRUE



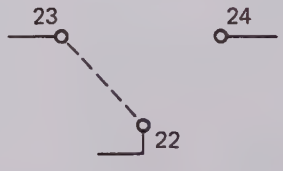
N. CONTROL WORD STROBE BIT
NEGATIVE–TRUE



O. DATA WORD STROBE BIT
POSITIVE–TRUE



P. DATA WORD STROBE
NEGATIVE–TRUE



Q. MAINFRAME ADDRESS
POSITIVE–TRUE

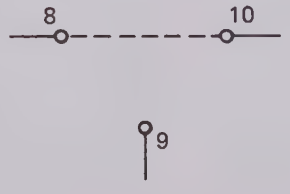
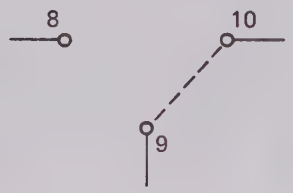
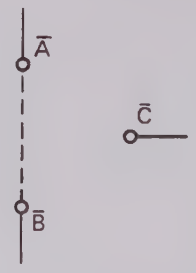


Figure 609-4. 4200-09 Jumper Connections (cont)

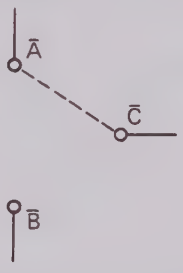
R. MAINFRAME ADDRESS NEGATIVE–TRUE



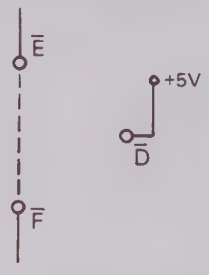
S. BINARY 16-BIT DATA WORD; LAST BIT NOT COMPLEMENTED



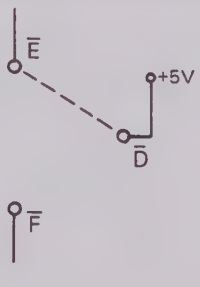
T. BINARY 16-BIT DATA WORD; COMPLEMENT ALL 16 BITS



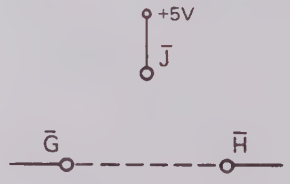
U. DATA WORD INITIATES DATA TRANSFER ACROSS GUARD



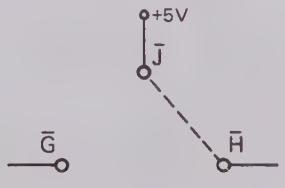
V. DATA WORD DOES NOT INITIATE TRANSFER ACROSS GUARD



W. CONTROL WORD INITIATES DATA TRANSFER ACROSS GUARD



X. CONTROL WORD DOES NOT INITIATE DATA TRANSFER ACROSS GUARD

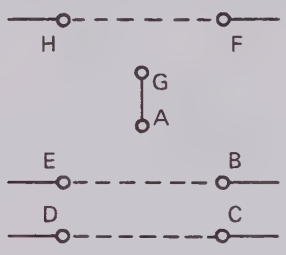


Y. NOT READY FLAG FIXED TIME DURATION

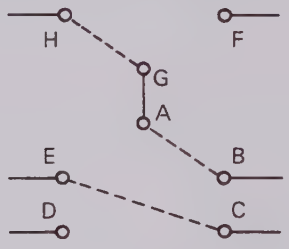
Figure 609-4. 4200-09 Jumper Connections (cont)

Z. NOT READY FLAG VARIABLE TIME DURATION

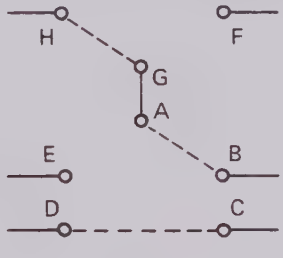
AA. BCD–POLARITY BIT IN EITHER DATA OR CONTROL WORD



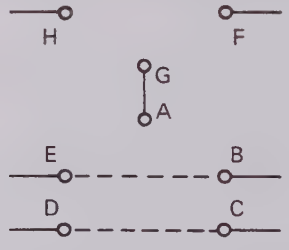
BB. BINARY–POLARITY BIT IN DATA WORD; STANDBY IN CONTROL WORD



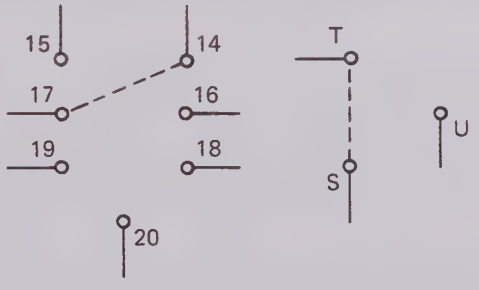
CC. BINARY–POLARITY BIT IN DATA WORD; STANDBY ASYNCHRONOUS



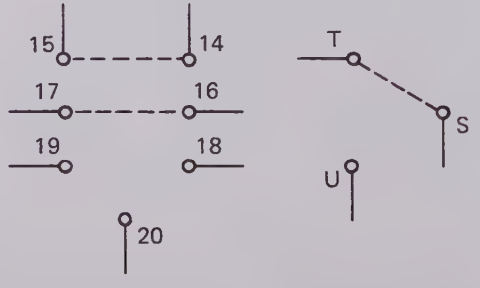
DD. BINARY-POLARITY IN CONTROL WORD; STANDBY ASYNCHRONOUS



EE. BINARY 16-BIT DATA WORD WITH POLARITY AS LAST BIT



FF. 18-BIT DATA WORD WITH POLARITY BIT



GG. 16-BIT DATA WORD WITH POLARITY IN CONTROL WORD

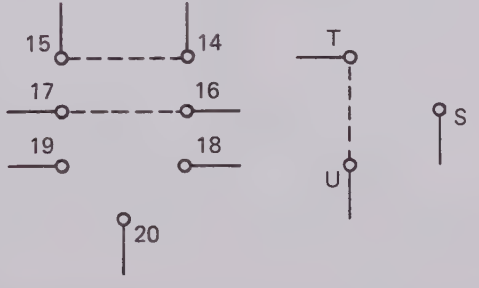
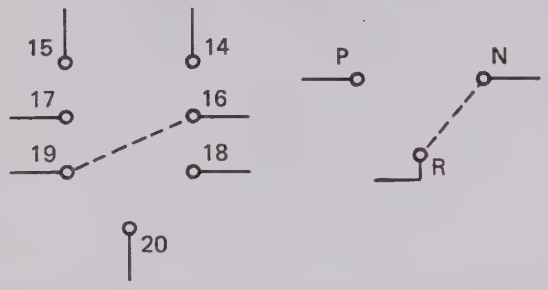
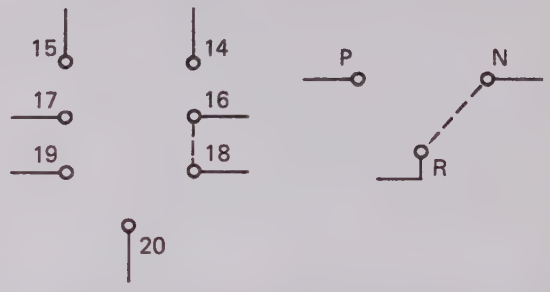


Figure 609-4. 4200-09 Jumper Connections (cont)

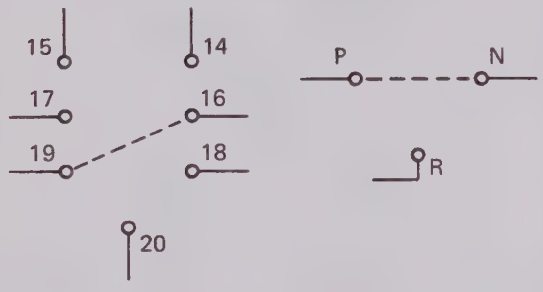
HH. STANDBY/OPERATE SYNCHRONOUS;
CONTROL WORD=POSITIVE–TRUE
STANDBY = POSITIVE – TRUE



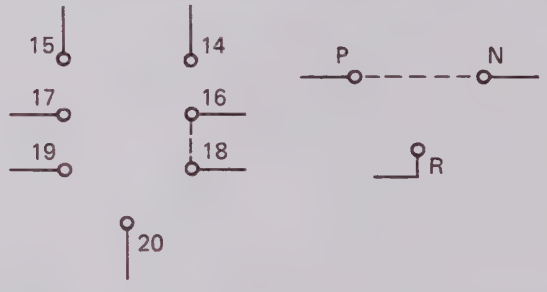
JJ. STANDBY/OPERATE SYNCHRONOUS;
CONTROL WORD=POSITIVE–TRUE
OPERATE = POSITIVE – TRUE



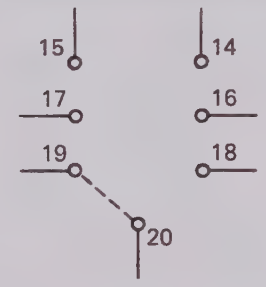
KK. STANDBY/OPERATE SYNCHRONOUS
CONTROL WORD=NEGATIVE–TRUE
STANDBY=POSITIVE–TRUE



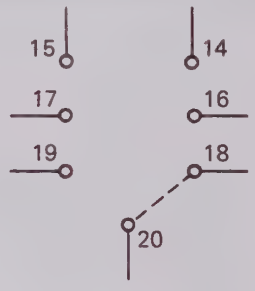
LL. STANDBY/OPERATE SYNCHRONOUS
CONTROL WORD=NEGATIVE–TRUE
OPERATE=POSITIVE–TRUE



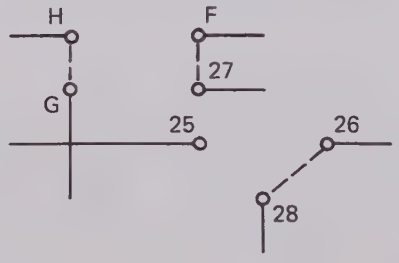
MM. STANDBY/OPERATE ASYNCHRONOUS;
STANDBY = POSITIVE – TRUE



NN. STANDBY/OPERATE ASYNCHRONOUS;
OPERATE = POSITIVE – TRUE



OO. 4275A–09 STANDARD BINARY



PP. 4275A POLARITY IN CONTROL WORD

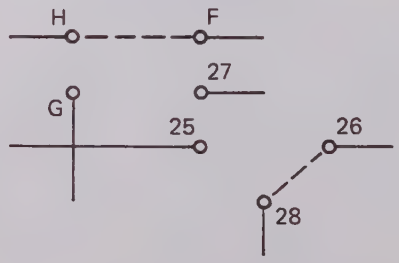


Figure 609-4. 4200-09 Jumper Connections (cont)

609-19. BINARY PROGRAM DATA COMPLEMENTING

609-20. Binary data words representing negative voltage outputs are two's complemented and must be recomplemented by the 4200-09 circuitry to obtain the required power source output polarity. When jumpering is performed to receive Binary data from the program source (pads, J, K, L, M, W, X and Y), complementing to accomplish this is automatically performed. Since the complementing process must not complement the polarity bit, one additional jumper is required to assure this.

609-21. The polarity bit may be either the last (16th) bit in the data word or the first bit in the control word. If it is the last bit in the data word, as shown in Figure 609-3, jumper pad $\overline{A}$ to pad $\overline{B}$. If polarity is indicated by a bit within the control word, the entire data word can be complemented. Jumper pad $\overline{A}$ to pad $\overline{C}$ to accomplish this.

609-22. When used in a 4275A Voltage Source, the standard 4200-09 Option jumper configuration includes pad F to pad 27, pad G to pad H and pad 26 to pad 28. The standard Binary data format may be used, but the two 4275A least significant bits of magnitude (the "1" bit and ".5" bit) will not be programmed. Only 14 magnitude bits will be programmed, with the polarity programming in place of the "1" bit and the ".5" bit unprogrammable. An optional jumper configuration is possible if the polarity bit is placed in the control word. By jumpering pad H to pad F and removing the jumpers between pads H and G and between pads F and 27, the 4275A "1" bit may be programmed. No jumper configuration will allow the ".5" bit to be programmed.

609-23. BCD Program Operation

609-24. BCD FORMAT

609-25. The standard program data format for BCD-type 4200 Voltage Sources consists of an 18-bit data word and a control word of 6-bits (refer to Figure 609-5). In the standard BCD format, the first four data bits program the most significant digit (MSD) of output magnitude; bits 5 through 8 program the second significant digit (2SD); bits 9 through 12 program the third significant digit (3SD); bits 13 through 16 program the least significant digit (LSD). Bit 17 programs the polarity, and bit 18 programs output range. The first control word data bit programs the external reference mode if the voltage source is equipped with the external reference option. The second control word data bit programs the current output limit range for those voltage sources equipped with current limit selection; control word bits 3 through 6 program the current limit magnitude. The advantage of the 18-bit data word is that it keeps the BCD output magnitude commands separate from the control commands. Output magnitude programming can thus be changed without effecting previously programmed control data. Also, if there is no current limit or external reference to be programmed, only one data word is necessary to control the voltage source. To obtain an 18-bit data word and 6-bit control word, the board comes with a jumper from pad T to pad S. (Refer to Figure 609-4.)

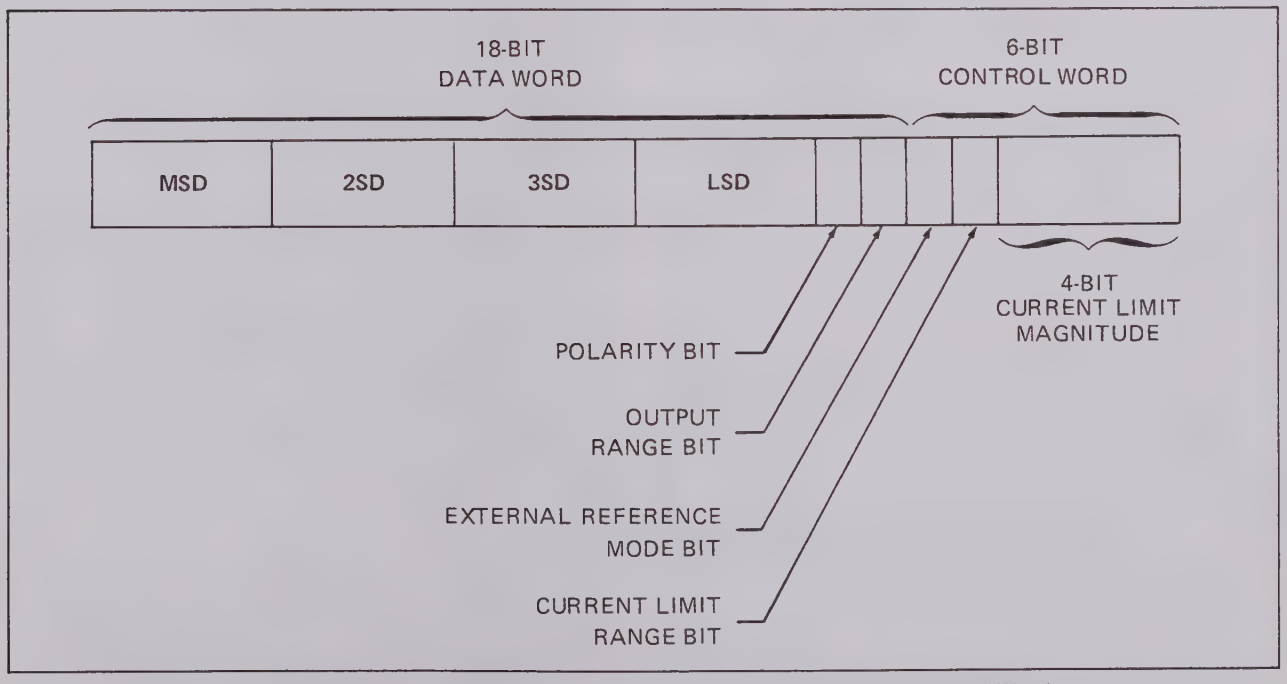


Figure 609-5. BCD Program Data, Typical 18-Bit Data Word, 6-Bit Control Word

609-26. A mainframe address bit for each voltage source being addressed is also required, but the address bits are not part of either the data word or control word. The address bit must be true for the source being addressed during both data word and control word loading. In the standard BCD format (18-bit data word and 6-bit control word) the standby/operate bit is not part of either word. Instead, a bit must be supplied for each voltage source because the jumpers are configured for asynchronous standby/operate transfer. Synchronous transfer is possible in the standard format, but polarity control must be sacrificed. (Refer to Figure 609-6.)

609-27. An optional BCD format using a 16-bit data word and an 8-bit control word is possible (refer to Figure 609-6). The data word consists of the 16-bits of BCD magnitude programming. The first control word bit is polarity (or standby/operate); the second bit selects the output range; the third bit is the external reference command; the fourth bit is the current limit range; and the fifth through eighth bits are current limit magnitudes. This format is obtained by jumpering pad T to pad U.

609-28. BCD LOGIC SENSE

609-29. Both the BCD data word and control word may be either positive-true logic or negative-true logic. Data word (16 or 18-bits) logic sense is determined by jumpering between pads J, K, L, M, V and W. Pad V must be jumpered to pad W for either BCD logic sense. The standard configuration is negative-true logic achieved by jumpering pad J to K and pad L to M. If positive-true logic is desired, jumper pad J to pad L and pad K to pad M. Also jumper pad F to pad H.

609-30. BCD control word logic sense may be either positive-true or negative-true, as determined by jumpering at pads N, P and R. The standard configuration is negative-true logic, established by jumpering pad P to pad N. If positive-true logic is required, jumper pad N to pad R. (Figure 609-4.)

NOTE

Positive-true logic employs +5V for logic 1 and 0V for logic 0.

609-31. BCD VOLTAGE SOURCE POLARITY

609-32. Voltage source output polarity is selected by a polarity data bit. The polarity bit may be placed in either an 18-bit data word or an 8-bit control word, depending on the data word length as selected through jumpering pads S, T, and U. With pad T jumpered to pad U, the data word will contain 16-bits; the Polarity bit will be the first data bit in the 8-bit control word. In the standard configuration, pad T is jumpered to pad S, and the data word contains 18-bits, with the Polarity bit being bit 17. In either case, jumper pad B to pad E. (Refer to Figure 609-4 and 609-6.)

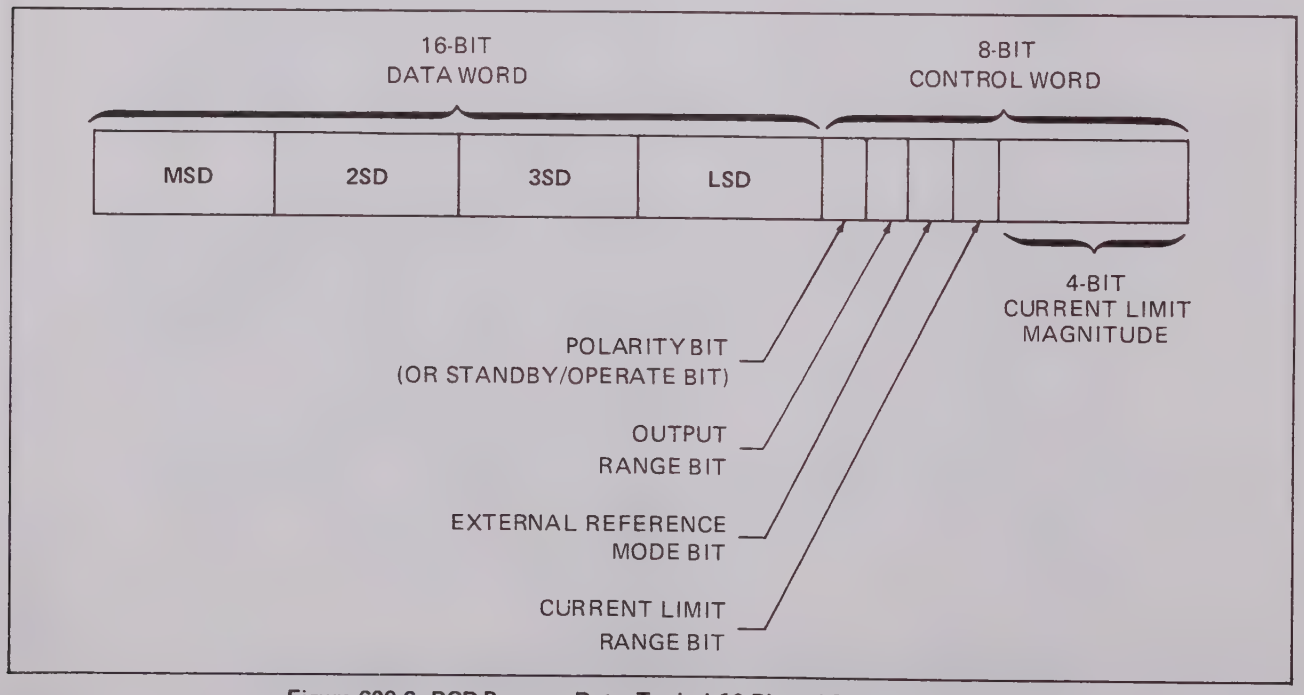


Figure 609-6. BCD Program Data, Typical 16-Bit and 8-Bit Data Words

609-33. Binary/BCD Program Operations

609-34. Program functions discussed in the following paragraphs apply to both BCD and Binary operation.

609-35. VOLTAGE SOURCE ADDRESSING

609-36. A 4200-09 Voltage Source receives program data only if it is addressed at the time it receives a strobe signal. The address signal may be either a high (+5V dc) or low 0V dc) logic level applied to address line number zero. Each Binary source, in the standard configuration, requires a positive-true address; each BCD source in the standard configuration, requires a negative-true address. For positive-true address levels, jumper pad 8 to pad 10. For negative-true address levels jumper pad 9 to pad 10.

609-37. A maximum of eight 4200-09 Voltage Sources may be individually addressed by one program source. Refer to Figure 609-2 for the multiple voltage source cable connection configuration. The voltage source electrically closest to the program source is numbered zero, and succeeding voltage sources are numbered consecutively one through seven. The program source supplies an address signal to each voltage source, for the duration of its programming sequence, on one of eight address lines (0-7).

609-38. Although the program source addresses the voltage sources on eight separate lines, each voltage source receives its address signal on address line zero. All eight program source addresses are applied to the address lines of the first voltage source, source number zero. Only address line zero supplies an address signal to the voltage source; all other addresses are shifted to the next lowest numerical address line (see Figure 609-7). The address signal originally issued on address line number one exits the first voltage source on address line number zero for use by the second voltage source. Each address signal is shifted by one address line position through each succeeding voltage source. Therefore, voltage source number seven (the eighth and last) receives only one address signal on the zero address line. Several voltage sources may be addressed at the same time, and each will receive the program data simultaneously. Table 609-4 lists the pin numbers of the 50-pin connector (on voltage source zero) used for addressing each voltage source in a multiple source system.

NOTE

In single-strobe Binary operation, the address need only be present when transferring the control word. When transferring the data word, the voltage source which last received a control word is automatically addressed.

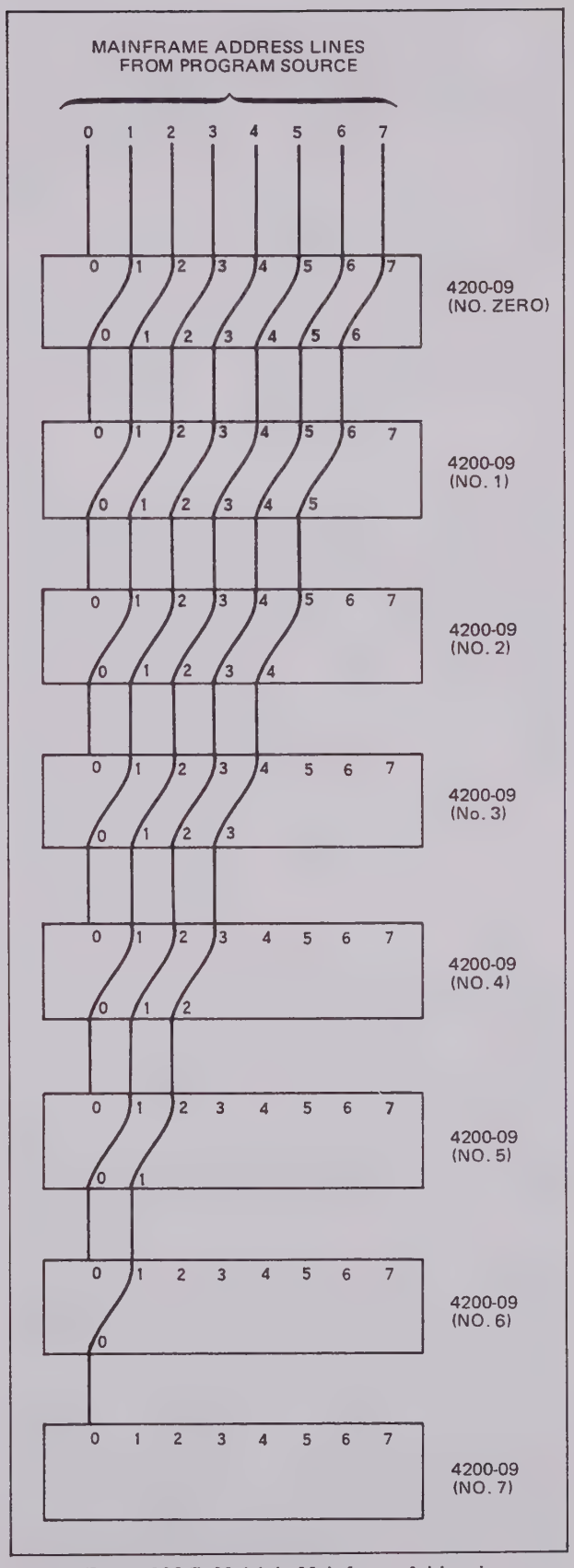


Figure 609-7. Multiple Mainframe Addressing

Table 609-4. Mainframe Addresses - Pin Assignments

POWER SOURCE MAINFRAME ADDRESS	PIN NUMBER (50-pin connector on power source no. zero)
0	20
1	50
2	49
3	48
4	47
5	46
6	45
7	21

609-39. STANDBY/OPERATE - SYNCHRONOUS OR ASYNCHRONOUS

609-40. All 4200-09 Voltage Sources can be placed in either a Standby or Operate condition by the program source. Jumper configurations on the 4200-09 Option pcbs determine whether the Standby/Operate command is synchronous (transferred with the data or control word) or asynchronous (transferred independently). Asynchronous Standby/Operate commands are executed immediately upon receipt by the voltage source; synchronous commands are transferred and executed with the program data transfer (Strobe pulse).

609-41. In the standard Binary operating mode, the program source supplies Standby/Operate commands on one line. That line goes to all voltage sources at Standby/Operate zero (pin 17 of the 50-pin rear panel connector). Binary Standby/Operate commands are transferred synchronously. In the standard BCD operating mode, the program source must supply one Standby/Operate line per unit. All BCD Standby/Operate lines go to the first unit in a system and chain down from unit to unit exactly as the address lines do. BCD Standby/Operate lines transfer asynchronously, thus they must be latched and maintained in the desired state at all times.

609-42. Standard Binary configuration uses a positive-true control word and a positive-true Standby command (Standby = 5V, Operate = 0V). Positive-true Standby requires a jumper from pad 16 to pad 19. If a positive-true Operate command is required, jumper pad 16 to pad 18. However, if a negative-true control word is in use (pad N jumpered to pad P), then a positive Standby command requires a jumper from pad 16 to pad 18. Operate positive-true commands require a jumper from pad 16 to pad 19 with a negative-true control word.

609-43. Standard BCD configuration uses an asynchronous Standby/Operate command, so control word logic sense is irrelevant. Operate positive-true commands require a jumper from pad 18 to pad 20; Standby positive-true commands require a jumper from pad 19 to pad 20. Either Standby/Operate logic sense requires a jumper from pad C to pad D.

609-44. CONTROL AND DATA WORD STROBE SIGNALS

609-45. The 4200-09 can program output voltages in both Single Strobe and Dual Strobe modes. Standard Binary voltage source configurations operate in the Single Strobe mode. Standard BCD voltage source configurations operate in the Dual Strobe mode. Single Strobe operation employs one Strobe Pulse line, but two Strobe Pulses. The condition of the Strobe Control line (true or false) determines whether a Strobe Pulse loads the control word or the data word. Dual Strobe operation employs two Strobe Pulse lines and two Strobe Pulses, one to load the control word and one to load the data word.

609-46. Single strobe operation employs one Strobe Pulse Line and one Strobe Control Line to load both the data word and control word into the 4200-09 storage registers. A Binary control word is loaded into the registers by placing the required logic level on the strobe control line and placing a strobe pulse on the control word strobe line. A Binary data word is loaded into the registers by reversing the strobe control line logic level and supplying a second strobe pulse. In this manner, a single strobe line is used to load both the data and control words by changing the strobe control line logic level.

609-47. Single strobe operation is established by jumpering pads 2, 3, 4, 11, 12 and 13. The standard configuration, Strobe Control line high (5V) to transfer the control word and low (0V) to transfer the data word, requires jumpers from pad 2 to pad 4 and from pad 11 to pad 12. To reverse the Strobe control logic sense, jumper pad 3 to pad 4 and leave the jumper from pad 11 to pad 12 in place. (Refer to Figure 609-4.)

609-48. Dual strobe operation requires two Strobe Pulses on two separate Strobe Pulse lines to load the data word and control word into the 4200-09 registers. A pulse on the data word strobe line loads a 16- or 18-bit data word into the the storage registers; a pulse on the control word strobe line loads the 6- or 8-bit control word into the registers.

609-49. Jumpering pad 1 to 4 and pad 11 to 13 establishes dual strobe operation. The standard dual strobe BCD configuration requires a jumper from pad 22 to pad 23 for the negative-true (0V) data word strobe, and a jumper from pad 6 to pad 7 for the negative control word strobe pulse. For a positive (5V) data word strobe pulse, jumper pad 23 to pad 24; for a positive control word strobe pulse, jumper pad 5 to pad 7. (Refer to Figure 609-4.)

609-50. Data word and control word Strobe Pulses, in both the single and dual strobe modes, are 1 μs or longer in width. Data on all programming lines must be valid

prior to the leading edge of the pulse, and it must remain unchanged for 100 ns after the strobe pulse trailing edge. A data word strobe, in the dual strobe mode, is issued after data is applied to the parallel data word inputs of the 4200-09 assembly. It loads the data bits into the parallel storage registers. In the dual strobe mode, the control word strobe loads only the control word from the program source into the storage registers; in the single strobe mode, the control word strobe pulse loads the data word into the registers when the strobe control line is at one logic level, then it loads the control word into the registers when the strobe control line is at the opposite logic level.

609-51. PROGRAM DATA TRANSFER

609-52. A control word strobe or data word strobe, generated by the program source, loads program data into the 4200-09 storage registers. The data (data word and control word) is transferred in a bit by bit serial fashion across the guard shield to the voltage source digital to analog converter. This transfer is initiated by the control word strobe, data word strobe, or both, as determined by jumpering between pads $\overline{D}$, $\overline{E}$, $\overline{F}$, $\overline{G}$, $\overline{H}$ and $\overline{J}$. (Refer to Figure 609-4.) The voltage source does not respond to newly programmed data until the transfer is complete.

609-53. For standard Binary or BCD configurations, entering either the data word or control word initiates a data transfer from the input shift registers to the voltage source. Standard jumpering is from pad $\overline{E}$ to pad $\overline{F}$ and from pad $\overline{G}$ to pad $\overline{H}$. If only the control word is to initiate a data transfer, jumper pad $\overline{G}$ to $\overline{H}$ and pad $\overline{D}$ to $\overline{E}$. If only the data word is to initiate data transfer, jumper pad $\overline{H}$ to pad $\overline{J}$ and pad $\overline{E}$ to pad $\overline{F}$.

NOTE

When either the data word or control word initiates a transfer, all data stored in the input shift registers is transferred. For example, if the transfer is initiated by a control word, then the previously entered data word is transferred along with the current control word.

609-54. VOLTAGE SOURCE STATUS FLAGS

609-55. Each 4200-09 provides four separate status indications to the program source. Each status indication (flag) uses a separate line, but corresponding status lines of all 4200-09 voltage sources within a multiple source system are bussed together. The status flags provided are:

1. Abnormal status (power off or current limit) flag.
2. Polled current limit flag.
3. Polled power off flag.
4. Not ready flag.

NOTE

All flag lines are wire-ORed to an open collector bus. Pull-up resistors are required in the program source for the flag lines to reach +5 volts.

609-56. Voltage source status checking is usually programmed to allow an abnormal status flag to interrupt the program source. As a result of the interrupt, the program source polls each 4200-09 in the system while monitoring both the polled current limit flag bus and the polled power off flag bus. The not ready flag is not polled, but when present, it indicates that the voltage source has not had sufficient time to settle at a newly programmed voltage level.

609-57. POLLED CURRENT LIMIT FLAG

609-58. Pin 29 of the voltage source 50-pin connector is the polled current limit line. As shown in Figure 609-8, all current limit lines in a multiple source system are bussed, but each voltage source poll status line (pin 9) is separate. To poll a voltage source status, the voltage source poll status line is usually tied to the address line if the address is negative-true. The voltage source can then supply current limit information on the polled current limit line each time it receives an address signal. When the voltage source uses a positive address (Binary), each poll status line (pin 9) may be grounded and a separate status flag line supplied for each flag. When polled, the current limit flag bus responds with a +5V level if that voltage source is not in a current limit condition.

609-59. POLLED POWER OFF FLAG

609-60. A power off flag is available when a voltage source is polled, as is the current limit flag. When the program source polls the power source, the poll status line is placed at ground level, and the power off status flag responds with a ground level if power is off. The voltage source can only respond with a ground level, indicating the power off condition, if +5 volts is supplied to pin 40 of the 50-pin connector. The external +5 volts is required for circuit operation if an actual power off condition exists.

609-61. INPUT LOADING

609-62. Each input of each 4200-09 voltage source represents a single TTL input load. In a multiple source system, the power requirements for each input of the first voltage source, exept the address and standby/operate inputs, increases by a factor representing the number of sources in the system. In BCD voltage sources, standby/operate inputs are single TTL loads as are the address lines. In Binary voltage sources, only the address lines are single loads; the standby/operate input loads in a multiple source system increase by a factor representing the number of sources in the system.

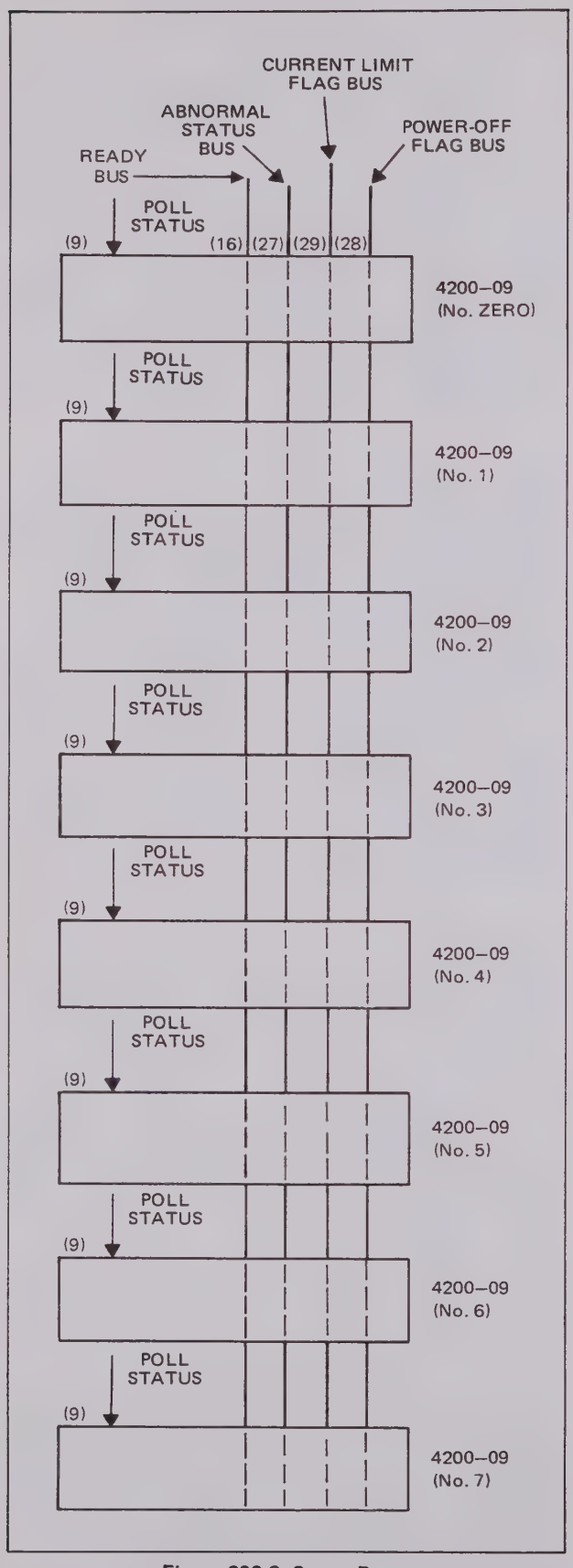


Figure 609-8. Status Busses

609-63. THEORY OF OPERATION

609-64. Overall Functional Description

609-65. Many diverse programming methods are possible, with different jumpering configurations, for all 4200-09 voltage sources. Since all possible configurations cannot be described in detail, these theory discussions are somewhat generalized. In any configuration, the primary function of the 4200-09 is to receive output magnitude data and control data, in parallel form, from a program source, and transfer that data across the voltage source guard shield to the voltage source D/A converter. Figure 609-9 is a simplified block diagram of the 4200-09, showing how data and control words are applied to shift registers in parallel form, clocked out of the registers in serial form, coupled across the guard shield and reconverted to parallel form for input to the voltage source D/A converter.

609-66. Upon receipt of a data word strobe or control word strobe, the control logic generates a load command to one or both shift registers. The data word and control word supplied by the program source and present at the shift register inputs, is loaded into the shift registers. When the shift registers are loaded with the program data, the control logic issues a hold command to the voltage source, then after a short delay, starts a 10 MHz clock.

609-67. Clock output pulses are fed to the shift registers to move the program data out of the registers, bit-by-bit, to the coupling transformers at the guard shield. When the program source indicates that the data word is a negative Binary number, the data word is shifted out of its storage register via two's complementing logic. This action is necessary since 4200 Binary Voltage Sources require positive Binary numbers in conjunction with a positive or negative polarity indicator. The control word undergoes no complementing at any time.

609-68. While the clock pulses are shifting program data across the guard shield, clock pulses are also being fed across the guard shield, and the hold one-shot is triggered as a result of the hold command issued by the control logic. On the inside of the guard shield, clock pulses shift the serial program data into shift registers which provide the necessary serial-to-parallel conversion. (The 4200 Voltage Sources require parallel program data.) The hold one-shot output is present for the duration of the serial data transfer across the guard shield. It inhibits any change in voltage source output magnitude while the data word is being serially loaded into the shift register.

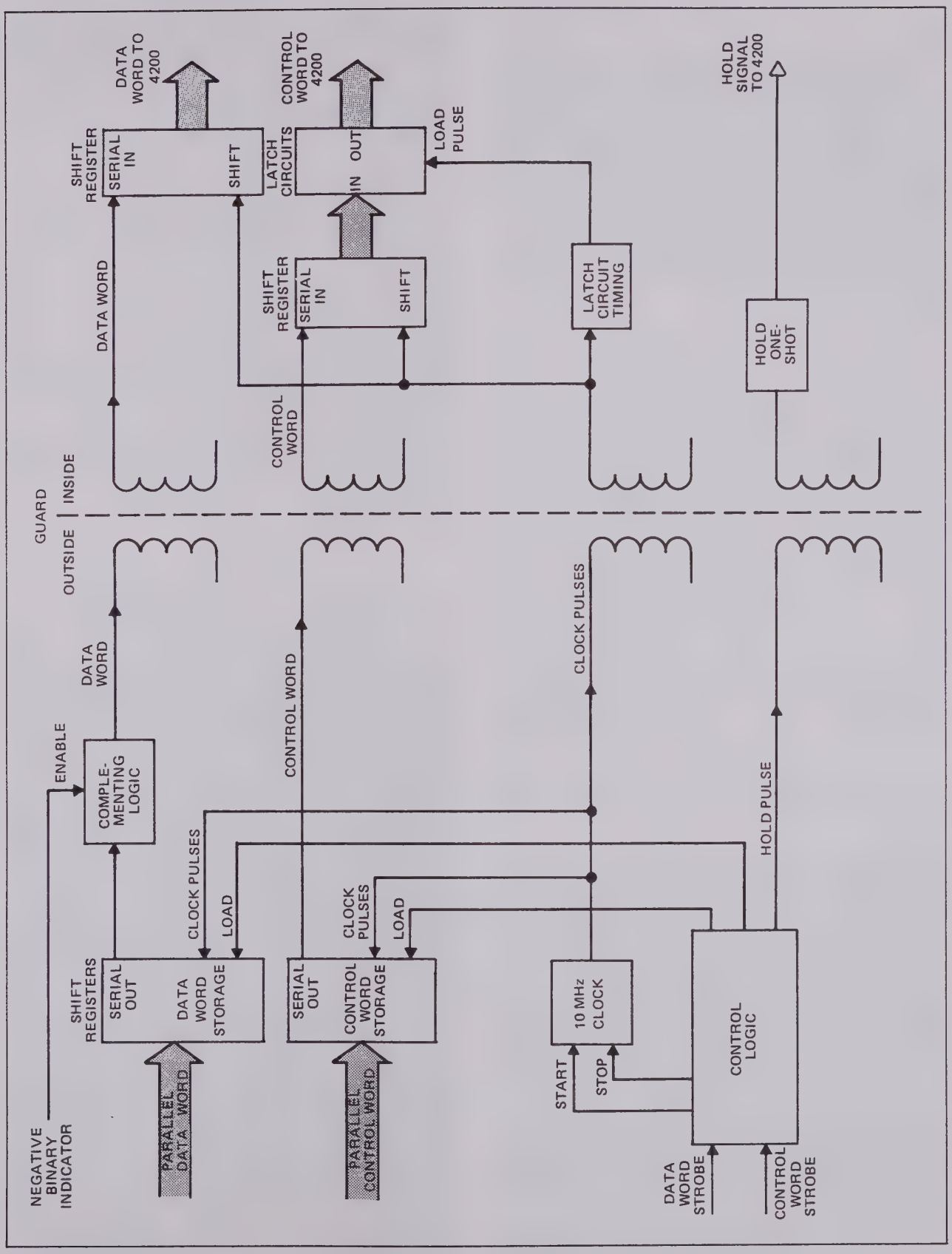


Figure 609-9. 4200-09 Simplified Block Diagram

609-69. The control word is also loaded into a shift register; it is double-buffered to prevent any change in voltage source output while loading is taking place. Double-buffering is provided by a series of latch circuits which receive a load pulse from a latch timing circuit. The latch timing circuit issues the load pulse to the latch circuits sometime after the last clock pulse when all data has been shifted into the registers. As the load pulse occurs, the latch circuits are loaded with the control word which they present in parallel form to the 4200 Voltage Source. (Double-buffering for the data word is not required since the hold signal "freezes" the voltage source output magnitude until the data word is completely loaded into the shift register.)

609-70. Clock pulses shift and load program data. Starting the clock pulses is a function of the control logic; stopping the clock pulses is also a function of the control logic, but after the generation of 16 pulses. When the clock is stopped, all shifting action ceases; and after the hold signal disappears and the load pulse to the latch occurs, all program data is presented to the digital-to-analog converter within the 4200 Voltage Source. At this time, the voltage source assumes its newly programmed output.

609-71. Block Diagram Analysis

609-72. INPUT SEQUENCE

609-73. Parallel program data, supplied by the program source, is applied to a pair of shift registers. (Refer to Figure 609-10.) Identical program data is supplied to all 4200-09 voltage sources in a multiple source system, but only those sources addressed by the program source will accept the data. Program data is loaded into the input registers only when an address signal and the appropriate strobe signal are present.

609-74. In a device configured for single-strobe operation, the control word strobe signal (in conjunction with the strobe control line) is used to load both the data word and control word into their respective registers. The strobe signal gating accepts the control word strobe from the program source, and depending upon the state (+5 volts or ground) of the strobe control line, directs the strobe signal to either the control word one-shot, or the data word one-shot. If the strobe control line directs the control strobe pulse to the control word one-shot, a pulse is generated and fed to the parallel-load input of the control word shift register. The pulse causes the shift register to load the parallel control word supplied by the program source. If the strobe control line directs the control strobe pulse to the data word one-shot, a pulse is fed to the parallel-load input of the data word shift register.

609-75. In a device configured for dual-strobe operation, both the control word strobe and data word strobe signals are used to load the program data from the program source. In this configuration, the control word strobe triggers the control word one-shot to load the control word into its shift register, and the data word strobe triggers the data word one-shot to load the data word. (Refer also to Figure 609-11.)

NOTE

For single strobe, dual strobe and strobe polarity jumpering configurations, refer to Figure 609-4.

609-76. DATA TRANSFER

609-77. Whenever the control word one-shot or data word one-shot is triggered, the resulting output triggers a first hold one-shot. (Refer also to Figure 609-11.) One output of the hold one-shot produces a hold pulse which is fed across the guard shield (via T2) to trigger a second hold one-shot. The second hold one-shot generates a hold pulse required by the voltage source to hold the output magnitude at the current value while magnitude data is being reprogrammed.

NOTE

The duration of the hold pulse depends upon the particular voltage source being used.

609-78. The trailing edge of the first hold one-shot output (triggered by the strobe signal) sets a data transfer flip-flop. The Q output of the data transfer flip-flop starts a 10 MHz clock, if not already operating (refer to Standby Sequence), and gates the clock pulses to the serial shift inputs of the control word and data word shift registers. (The clock pulses are also gated to the input of the ÷ 16 counter and to the primary winding of T4.) As each clock pulse is received by the shift registers, the previously loaded program data is shifted, serial-by-bit, out of the shift registers to the coupling transformers (T3 and T5) at the guard shield. On the inside of the guard shield, the serial data and control words are loaded into a second set of shift registers which are clocked by the pulses at the secondary of T4.

609-79. Clock pulses gated by the data transfer flip-flop are also fed to a 4-bit Binary counter which produces a carry pulse at the time of the sixteenth clock pulse. The carry pulse resets the data transfer flip-flop to inhibit the gating of the clock pulses and stop the clock, if the standby mode is not present. (Refer to Standby Sequence.) After the generation and gating of 16 clock pulses, the data has shifted completely around the shift register and has been restored in the register exactly as it was prior to the data transfer. Data has also been transformer-coupled across the guard and into the second shift register for application to the 4200 Voltage Source.

The control word, since it contains eight bits or less, is actually shifted around the control word register, across the guard and into the second control word register two complete times during the 16 clock pulses.

609-80. The control word is double-buffered for application to the 4200 Voltage Source. This is necessary since the hold signal, provided during data transfer by the second hold one-shot, does not "freeze" the output range of the 4200 Voltage Source, just the output magnitude. To parallel shift the control word from the shift register to a set of latch circuits, the first of the 16 clock pulses triggers a latch timing one-shot which has a pulse width slightly greater than the serial data transfer time (16 clock pulses). The trailing edge of the latch timing one-shot output is fed to a pulse generator which provides a load pulse to the latch circuits. At the time of the load pulse, the latch circuits are parallel loaded with the control word for application to the 4200 Voltage Source.

609-81. COMPLEMENTING BINARY DATA

NOTE

Complementing magnitude data occurs only in Binary-type voltage sources.

609-82. Binary program sources usually supply two's complemented magnitude data, and a polarity bit for negative outputs. Binary type voltage sources require non-complemented Binary data and a polarity bit. Therefore, negative Binary magnitude data (complemented data) from the program source must be recomplemented to satisfy voltage source requirements.

609-83. The first bit of serial data is present at the shift register output before the ÷ 16 counter and complement flip-flop receive the first of 16 clock pulses. At that time, the ÷ 16 counter is in its zero state and the complement flip-flop is still reset, a result of the ÷ 16 counter carry pulse at the end of the previous data transfer. With the complement flip-flop in a reset state, the complement logic is disabled, and no inversion of serial data occurs. Data will be serially shifted until the first "1" data bit. With a "1" at the complement flip-flop, the trailing edge of the clock pulse sets the complement flip-flop. The first "1" bit is therefore tranferred non-inverted. All data bits after the first one are inverted, except the last bit which is the polarity bit. The carry output from the ÷ 16 counter is coincident with the last clock pulse, so the leading edge of the carry pulse resets the complement flip-flop. Since this takes place just prior to the last data bit, the last bit is tranferred non-inverted. If it is necessary to invert the last data bit, pad $\overline{A}$ may be jumpered to pad $\overline{C}$, placing U13 in the carry bit circuit to produce a delay. With the carry bit delayed, the last data bit will be complemented before the complement flip-flop is reset.

609-84. STANDBY OPERATION

609-85. Programming the 4200 Voltage Source to standby (zero output, but no change in programmed magnitude and range) may be performed in a synchronous or asynchronous manner, depending on jumper configuration. With synchronous standby operation, the standby bit supplied by the program source becomes part of the control word and is serially shifted across the guard for application to the standby input of the 4200 Voltage Source. This mode is referred to as synchronous standby because commanding the 4200 Voltage Source to standby or operate is always synchronous with a strobe signal from the program source.

609-86. With the 4200-09 jumper configured for asynchronous standby operation, the voltage source can be commanded to either the standby or operate mode independent of data transfer. The standby signal, a dc level, is gated to the 10 MHz clock to initiate clock pulse generation. If a data transfer sequence is not in progress, the data transfer flip-flop will be in its reset condition. Clock pulses and the data transfer flip-flop Q output (false) must be coincident for standby pulses to be gated across guard shield transformer T2. With the data transfer flip-flop in the reset state, the Q output prohibits clock pulses from reaching the ÷ 16 counter and the shift registers. Clock pulses, from the secondary winding of transformer T2, are input for a half-wave rectifier. The rectifier produces a dc output to the 4200 Voltage Source standby/operate input.

609-87. NOT READY SIGNAL

609-88. A Not Ready signal is initiated when a strobe signal initiates data transfer. Strobe signal gating circuitry triggers either the Control Word One-Shot or the Data Word One-Shot. They, in turn, trigger the First Hold One-Shot. The First Hold One-Shot triggers the Data Transfer Flip-Flop and the Not Ready One-Shot. The Not Ready One-Shot pulse is present through the data transfer time and lasts until the voltage source settles at its newly programmed output. Not Ready pulse duration is dependent on component selection.

609-89. Resistive and capacitive components in the Not Ready One-Shot circuit are selectable to establish different one-shot signal durations. A fixed time period is established by component selection with pad M jumpered directly to pad L. A variable time period is possible if a potentiometer is installed between pad M and pad L in place of the jumper. (Refer to Figure 609-4.)

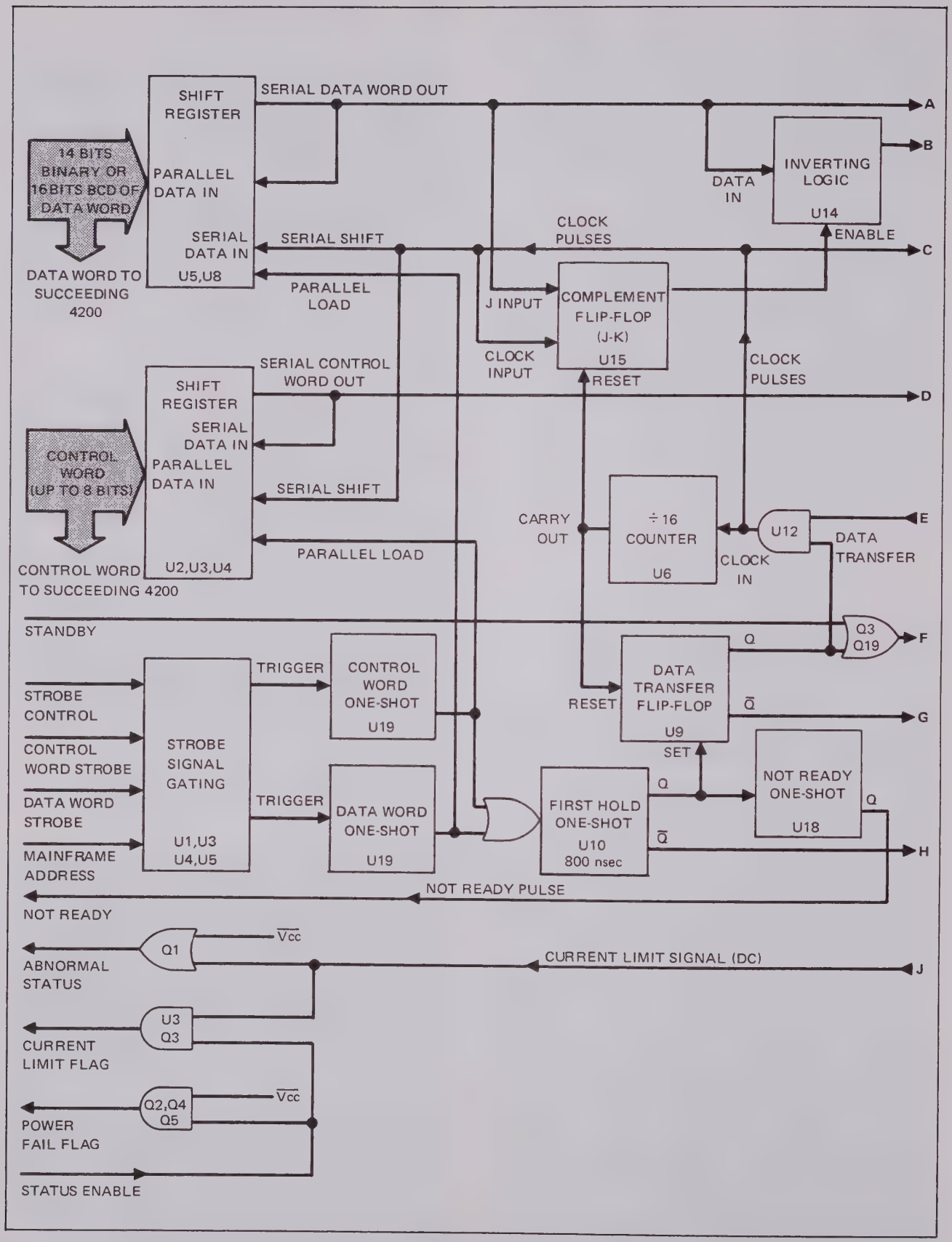


Figure 609-10. 4200-09 Functional Block Diagram

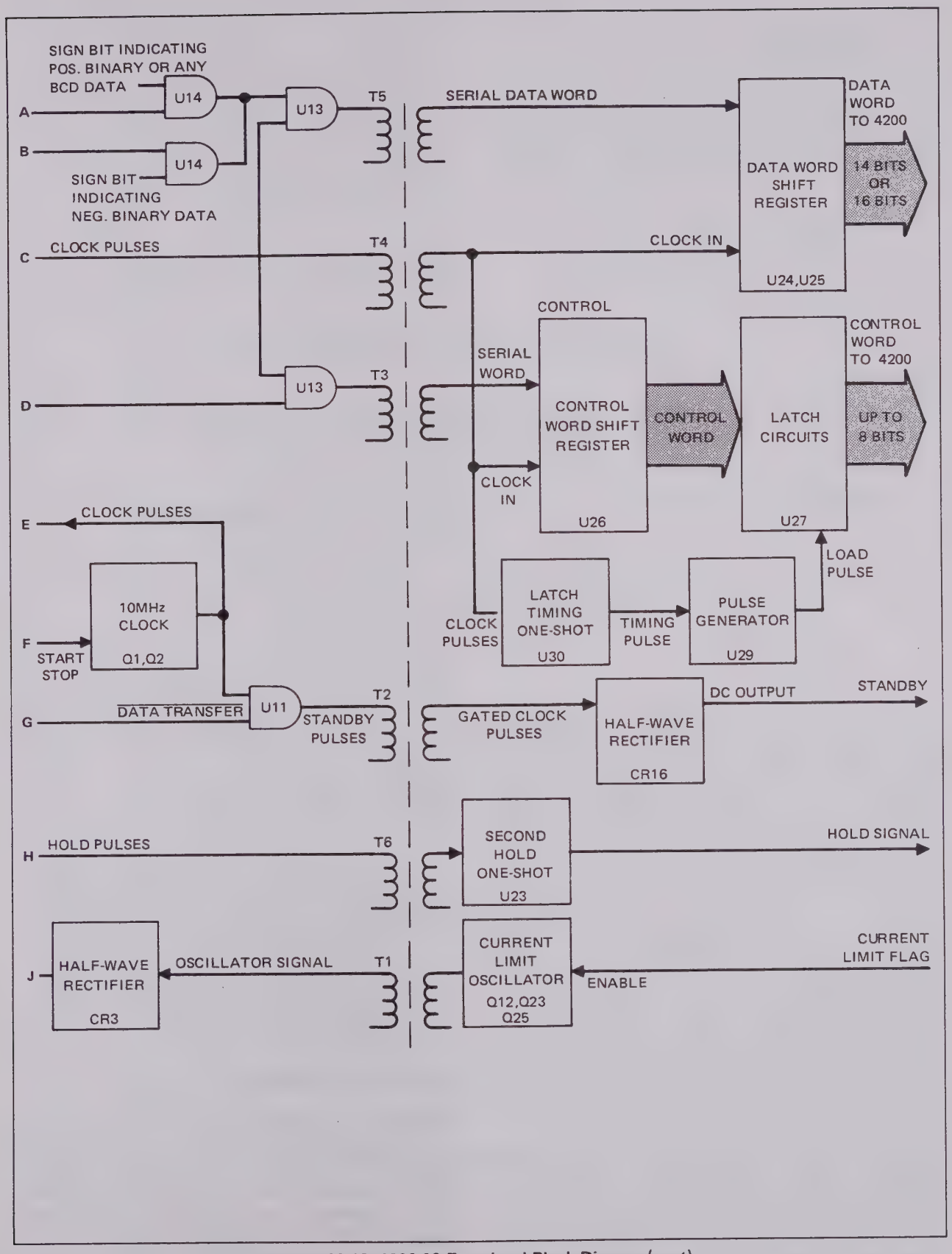


Figure 609-10. 4200-09 Functional Block Diagram (cont)

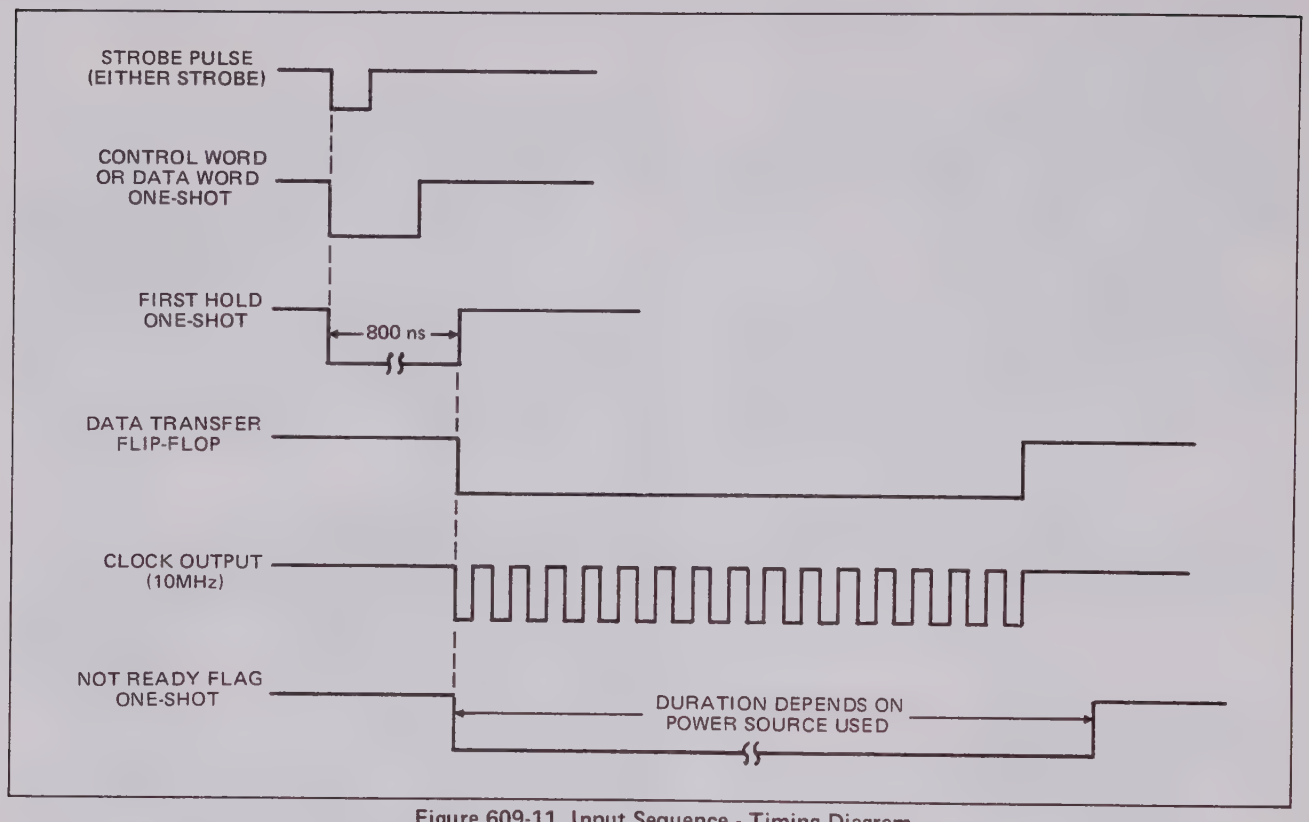


Figure 609-11. Input Sequence - Timing Diagram

609-90. STATUS LOGIC

609-91. Voltage sources, through the 4200-09, can provide two status indications: current limit and power failure. Either status indication is accompanied by an Abnormal Status flag, usually used as a program source interrupt to initiate a status poll sequence. The voltage source supplies a current limit indication when an overload condition exists and the current limit function is in use. The Power Fail flag is generated within the 4200-09 Multi-Strobe Isolated Logic.

609-92. A Current Limit flag occurs when the voltage source generates a current limit signal. The current limit signal is passed to the 4200-09 Option, where it enables a current limit oscillator circuit. Oscillator output, coupled across T1, is half-wave rectified, then AND gated with the program source Status Enable signal to produce a Current Limit flag output. The current limit signal from the rectifier, through OR gating, also initiates an Abnormal Status flag.

609-93. A Power Fail flag occurs when the voltage to the 4200-09 logic fails. Power Fail flag circuitry requires a positive 5V input to supply Vcc to the power fail logic when power does fail. Under normal operating conditions, Vcc maintains a high logic state at one input of an AND circuit. The poll status signal at the other input is ground level so no output is produced. If Vcc should fail, then low logic levels will be present at both inputs and the Power Fail flag will respond with a low logic output. The Abnormal Status line will also respond with low logic out.

609-94. MAINTENANCE

WARNING

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

609-95. Performance Test

609-96. Proper 4200-09 operation is best verified in a normal operating environment. With the 4200-09 installed in a voltage source and connected to a program source, diagnostic routines may be used or manually-entered statements from an operator interface may be employed to test performance. The specific procedure will necessarily vary with each system.

NOTE

A manual test fixture, Fluke part number A4209, may be used in conjunction with an A4200 manual control unit for test purposes. It is available from the Parts Department, John Fluke Mfg. Co. Inc., P.O. Box 43210, Mountlake Terrace, WA 98043; telephone (206) 774-2211. Send all orders or inquiries to the attention of the Parts Department Manager.

609-97. The 4200-09 requires no adjustment, either periodically or after repair.

609-98. Troubleshooting Procedures

609-99. Troubleshooting information is presented in six separate tables. The first table, Table 609-5, is an overall Malfunction Isolation Procedure; each of the remaining five tables provides troubleshooting procedures dependent on the malfunction symptom. The preceding theory of operation should be read and understood prior to troubleshooting.

NOTE

Place 4200-09 pcb assembly on an extender card (Fluke part number 292263) for access during troubleshooting.

Table 609-5. Troubleshooting Chart, Inactive Module

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
1	Does Control or Data Word One-Shot fire when strobed?	5	2
2	Is the strobe pulse ≥ 1 μs?	4	3
3	Check strobe pulse source.		
4	Check logic elements preceding one-shot.		
5	Does First Hold One-Shot fire?	7	6
6	Repair First Hold One-Shot circuit.		
7	Does Data Transfer Flip-Flop, pin 6, go to Logic 0 (1.6 μs)?	9	8
8	Check logic elements between First Hold One-Shot and Data Transfer Flip-Flop.		
9	Is clock generating 10 MHz?	11	10
10	Check and repair clock circuit.		
11	Are clock pulses present at pin 8 of the shift register inside the guard?	13	12
12	Check all elements between clock circuit and shift registers.		
13	Is serial data present at guard transformers?	15	14
14	Check input shift registers and logic elements.		
15	Is serial data present at shift registers inside the guard?	17	16
16	Check transistors and amplifiers between guard transformers and shift registers inside guard.		
17	Does parallel data appear at outputs of shift registers inside the guard?	19	18
18	Check shift registers inside the guard.		
19	Perform the Voltage Source troubleshooting procedure in the applicable Voltage Source Instruction Manual.		

Table 609-6. Troubleshooting Chart, Data Errors at Parallel Outputs

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
1	Is program data correct at parallel input shift registers?	3	2
2	Check the program data source.		
3	Is serial data correct at output of the shift registers?	7	4
4	Is program data shifted on position to the left or right?	6	5
5	Check appropriate input shift register.		
6	Check the divide by 16 counter.		
7	Check the serial inputs and parallel outputs of the shift registers inside the guard.		

Table 609-7. Troubleshooting Chart, No Binary Data Complementing

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
1	Does polarity storage flip-flop output change states between positive and negative data?	7	2
2	Do polarity storage flip-flop inputs change states between positive and negative data?	4	3
3	Check the polarity input line and inverters.		
4	Does the polarity storage flip-flop receive a clock pulse?	6	5
5	Check all strobe input logic elements.		
6	Replace the polarity storage flip-flop.		
7	Does the complement flip-flop change states after the first true data bit?	9	8
8	Replace the complement flip-flop.		
9	Check all gates of the inverting and complemented data gating chip.		

Table 609-8. Troubleshooting Chart, No Asynchronous Standby

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
1	Are clock pulses present at pin 13 of U11 when standby selected?	5	2
2	Is pin 11 of U12 at Logic 0?	4	3
3	Check Standby/Operate input line.		
4	Check 10 MHz clock.		
5	Is pin 12 of U11 at Logic 0?	7	6
6	Check data transfer flip-flop and divide by 16 counter carry output.		
7	Is U21 input (pin 13) at +2V or higher?	9	8
8	Check elements in primary and secondary circuits of T2.		
9	Check for excessive ripple at input (pin 13) of U21. *NOTE:* *Logic 1 = zero to 0.4V* *Logic 0 = +2V to +5V*		

Table 609-9. Troubleshooting Chart, No Current Limit Flag

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
1	Is poll status line at zero volts?	3	2
2	Place zero volts on poll status line.		
3	Is the output of the half wave rectifier circuit zero volts?	7	4
4	Is junction of CR3 and C15 greater than +2V?	8	5
5	Is AC signal present at collector of Q12?	9	6
6	Troubleshoot current limit oscillator and/or power source flag input.		
7	Check current limit flag status gate logic.		
8	Replace amplifier U7 and check for excessive ripple of CR3.		
9	Check T1 and associated circuitry.		

Table 609-10. Troubleshooting Chart, No Power Fail and/or Abnormal Status Flag

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
1	Are both Abnormal Staus and Power Fail flags malfunctioning?	2	3
2	Check Vcc (+5V) supply from Program Source.		
3	Has the Abnormal Status flag failed?	5	4
4	Check Polled Power Fail flag status gate logic.		
5	Does Current Limit flag operate normally?	6	7
6	Check Abnormal Status flag status gate circuitry.		
7	Troubleshoot Current Limit flag circuitry.		

609-100. ILLUSTRATED PARTS LIST

609-101. Components in the illustrated parts breakdown are listed alphanumerically by assembly. See Table 609-11. Electrical and mechanical components are listed by reference designation. Each listed part is shown in an accompanying illustration. For parts ordering information, refer to Section 5.

NOTE

The following parts list includes timing components necessary to use the 4200-09 Option in a 4210A or 4216A Voltage Source. See Addendum 609-11A, for component values and Fluke part numbers used in 4200-09 Option units installed in 4250A, 4265A, 4270A and 4275A Voltage Sources.

Table 609-11. Multi-Strobe Isolated Logic PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	MULTI-STROBE ISOLATED LOGIC PCB ASSY. FIGURE 6-12	345660	89536	345660			
C1	CAP, MICA, 12 PF +/-5%, 500V	175224	72136	DM15E120J	2		
C2	CAP, MICA, 12 PF +/-5%, 500V	175224	72136	DM15E120J	REF		
C3	CAP, MICA, 750 PF +/-5%, 500V	208983	72136	DM19F751J	1		
C4	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015	1		
C5	CAP, MICA 220 PF +/-5%, 500V	170423	72136	DM15F221J	2		
C6	CAP, MICA, 470 PF +/-5%, 500V	148429	72136	DM19F471J	1		
C7	CAP, MICA, 1000 PF +/-5%, 500V	148387	72136	DM19F102J	1		
C8	CAP, MICA, 70 PF +/-5%, 500V	148494	72136	DM15F700J	3		
C9	CAP, MICA, 70 PF +/-5%, 500V	148494	72136	DM15F700J	REF		
C10	CAP, MICA, 270 PF +/-5%, 500V	148452	72136	DM15F271J	1		
C11	CAP, FILM, 0.0033 PF +/-2%, 150V	168344	84171	PE332G	1		△A
C15	CAP, CER, 0.01 UF +/-20%, 100V	149153	56289	C023B101F103	2		
C20	CAP, MICA, 330 PF +/-1%, 500V	226142	72136	DM15E331F	1		△A
C21	CAP, MICA, 70 PF +/-5%, 500V	148494	72136	DM15F700J	REF		
C22	CAP, MYLAR, 0.1 UF +/-10%, 50V	271866	06001	75F2R5A104	1		
C34	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253	19		
C35	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253	REF		
C36	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253	REF		
C37	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253	REF		
C38	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253	REF		
C39	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253	REF		
C40	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253	REF		
C41	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253	REF		
C42	CAP, ELECT, 200 UF +/-50%, 10V	236935	73445	ET221X010A5	2		
C43	CAP, ELECT, 200 UF +/-50%, 10V	236935	73445	ET221X010A5	REF		
C44	CAP, MICA, 56 PF +/-5%, 500V	148528	72136	DM15F560J	5		
C45	CAP, MICA, 56 PF +/-5%, 500V	148528	72136	DM15F560J	REF		
C46	CAP, MICA, 56 PF +/-5%, 500V	148528	72136	DM15F560J	REF		
C47	CAP, MICA, 56 PF +/-5%, 500V	148528	72136	DM15F560J	REF		
C48	CAP, MICA 220 PF +/-5%, 500V	170423	72136	DM15F221J	REF		
C49	CAP, MICA, 56 PF +/-5%, 500V	148528	72136	DM15F560J	REF		
C53	CAP, CER, 0.01 UF +,-20%, 100V	149153	56289	C023B101F103	REF		
C55	CAP, CER, .0027 PF +/-GMV, 600V	106211	72982	851.000Z5U0-272P	1		
C56	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253	REF		
C57	CAP, CER, .0033 UF +/-GMV, 600V	106674	56289	C023B102F332M	1		
C58	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253	REF		
C59	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253	REF		
C60	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253	REF		
C61	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253	REF		
C62	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253	REF		
C63	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253	REF		
C64	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253	REF		
C65	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253	REF		
C66	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253	REF		
C67	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253	REF		
C68	CAP, MICA, 430 PF +/-5%, 500V	177980	72136	DM15F431J	3		
C69	CAP, MICA, 430 PF +/-5%, 500V	177980	72136	DM15F431J	REF		
C70	CAP, MICA, 430 PF +/-5%, 500V	177980	72136	DM15F431J	REF		

Table 609-11. Multi-Strobe Isolated Logic PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
CR1	DIODE, SI, 150 MA	203323	04713	1N4448	7		
CR2	DIODE, HOT CARRIER	313247	28480	2811	7	2	
CR3	DIODE, HOT CARRIER	313247	28480	2811	REF		
CR4	DIODE, HOT CARRIER	313247	28480	2811	REF		
CR5	DIODE, HOT CARRIER	313247	28480	2811	REF		
CR6	DIODE, HOT CARRIER	313247	28480	2811	REF		
CR7	DIODE, SI, 150 MA	203323	04713	1N4448	REF		
CR8	DIODE, SI, 150 MA	203323	04713	1N4448	REF		
CR9	DIODE, SI, 150 MA	203323	04713	1N4448	REF		
CR10	DIODE, SI, 150 MA	203323	04713	1N4448	REF		
CR11	DIODE, HOT CARRIER	313247	28480	2811	REF		
CR12	DIODE, HOT CARRIER	313247	28480	2811	REF		
CR15	DIODE, SI, 150 MA	203323	04713	1N4448	REF		
CR16	DIODE, SI, 150 MA	203323	04713	1N4448	REF		
Q1	XSTR, SI, NPN	159855	07910	CS23030	17	6	
Q2	XSTR, SI, NPN	159855	07910	CS23030	REF		
Q3	XSTR, SI, NPN	159855	07910	CS23030	REF		
Q6	XSTR, SI, NPN	159855	07910	CS23030	REF		
Q7	XSTR, SI, NPN	159855	07910	CS23030	REF		
Q8	XSTR, SI, NPN	159855	07910	CS23030	REF		
Q10	XSTR, SI, NPN	159855	07910	CS23030	REF		
Q11	XSTR, SI, NPN	159855	07910	CS23030	REF		
Q12	XSTR, SI, NPN	159855	07910	CS23030	REF		
Q13	XSTR, SI, UNIJUNCTION	268110	03508	2N6027	1	1	
Q14	XSTR, SI, NPN	159855	07910	CS23030	REF		
Q16	XSTR, SI, NPN	159855	07910	CS23030	REF		
Q17	XSTR, SI, NPN	159855	07910	CS23030	REF		
Q18	XSTR, SI, NPN	159855	07910	CS23030	REF		
Q19	XSTR, SI, NPN	159855	07910	CS23030	REF		
Q20	XSTR, SI, NPN	159855	07910	CS23030	REF		
Q23	XSTR, SI, NPN	168716	12040	SM07154	1		
Q25	XSTR, SI, PNP	195974	04713	2N3906	1	1	
Q26	XSTR, SI, NPN	159855	07910	CS23030	REF		
Q27	XSTR, SI, NPN	159855	07910	CS23030	REF		
R1	RES, COMP, 1K+/-5%, 1/4W	148023	01121	CB1025	12		
R2	RES, COMP, 10K+/-5%, 1/4W	148106	01121	CB1035	2		
R3	RES, COMP, 510+/-5%, 1/4W	218032	01121	CB5115	8		
R4	RES, COMP, 10K+/-5%, 1/4W	148106	01121	CB1035	REF		
R5	RES, COMP, 470+/-5%, 1/4W	234252	01121	CB1325	1		
R6	RES, COMP, 1.3K+/-5%, 1/4W	234252	01121	CB1325	1		
R7	RES, COMP, 390+/-5%, 1/4W	147975	01121	CB3915	5		
R8	RES, COMP, 390+/-5%, 1/4W	147975	01121	CB3915	REF		
R9	RES, COMP, 510+/-5%, 1/4W	218032	01121	CB5115	REF		
R10	RES, COMP, 510+/-5%, 1/4W	218032	01121	CB5115	REF		
R11	RES, MTL FLM, 6.98K+/-1%, 1/8W	261685	91637	MFF1-86981F	2		
R13	RES, COMP, 510+/-5%, 1/4W	218032	01121	CB5115	REF		
R14	RES, COMP, 390+/-5%, 1/4W	147975	01121	CB3915	REF		
R15	RES, MTL FLM, 4.99K+/-1%, 1/8W	168252	91637	MFF1-84991F	2		
R16	RES, COMP, 11+/-5%, 1/4W	221861	01121	CB1105	2		
R17	RES, MTL FLM, 4.99K+/-1%, 1/8W	168252	91637	MFF1-84991F	REF		

Table 609-11. Multi-Strobe Isolated Logic PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R18	RES, COMP, 51+/-5%, 1/4W	221879	01121	CB5105	6		
R19	RES, MTL FLM, 29.4K+/-1%, 1/8W	235135	91637	MFF1-82942F	1		A
R20	RES, COMP, 2.7K +/-5%, 1/4W	170720	01121	CB2725	1		
R21	RES, COMP, 510+/-5%, 1/4W	218032	01121	CB5115	REF		
R22	RES, COMP, 1K+/-5%, 1/4W	148023	01121	CB1025	REF		
R23	RES, COMP, 510+/-5%, 1/4W	218032	01121	CB5115	REF		
R24	RES, COMP, 1K+/-5%, 1/4W	148023	01121	CB1025	REF		
R26	RES, COMP, 51+/-5%, 1/4W	221879	01121	CB5105	REF		
R28	RES, COMP, 1K+/-5%, 1/4W	148023	01121	CB1025	REF		
R30	RES, COMP, 430+/-5%, 1/4W	203869	01121	CB4315	1		
R32	RES, COMP, 200+/-5%, 1/4W	193482	01121	CB2015	4		
R35	RES, COMP, 3.3K+/-5%, 1/4W	148056	01121	CB3325	6		
R36	RES, COMP, 1K+/-5%, 1/4W	148023	01121	CB1025	REF		
R37	RES, COMP, 200+/-5%, 1/4W	193482	01121	CB2015	REF		
R38	RES, COMP, 200+/-5%, 1/4W	193482	01121	CB2015	REF		
R39	RES, COMP, 3.3K+/-5%, 1/4W	148056	01121	CB3325	REF		
R40	RES, MTL FLM, 30.9K+/-1%, 1/8W	235275	91637	MFF1-83092F	1		A
R42	RES, COMP, 390+/-5%, 1/4W	147975	01121	CB3915	REF		
R43	RES, COMP, 11+/-5%, 1/4W	221861	01121	CB1105	REF		
R45	RES, COMP, 1K+/-5%, 1/4W	148023	01121	CB1025	REF		
R47	RES, COMP, 27K+/-5%, 1/4W	148148	01121	CB2735	1		
R48	RES, COMP, 3.3K+/-5%, 1/4W	148056	01121	CB3325	REF		
R49	RES, COMP, 39K+/-5%, 1/4W	188466	01121	CB3935	1		
R50	RES, COMP, 390+/-5%, 1/4W	147975	01121	CB3915	REF		
R51	RES, COMP, 100+/-5%, 1/4W	147926	01121	CB1015	1		
R54	RES, COMP, 3.3K+/-5%, 1/4W	148056	01121	CB3325	REF		
R59	RES, COMP, 1K+/-5%, 1/4W	148023	01121	CB1025	REF		
R60	RES, COMP, 1K+/-5%, 1/4W	148023	01121	CB1025	REF		
R61	RES, COMP, 1K+/-5%, 1/4W	148023	01121	CB1025	REF		
R62	RES, COMP, 680+/-5%, 1/4W	148007	01121	CB6815	3		
R63	RES, COMP, 51+/-5%, 1/4W	221879	01121	CB5105	REF		
R64	RES, COMP, 51+/-5%, 1/4W	221879	01121	CB5105	REF		
R65	RES, COMP, 51+/-5%, 1/4W	221879	01121	CB5105	REF		
R67	RES, COMP, 680+/-5%, 1/4W	148007	01121	CB6815	REF		
R68	RES, COMP, 680+/-5%, 1/4W	148007	01121	CB6815	REF		
R69	RES, COMP, 510+/-5%, 1/4W	218032	01121	CB5115	REF		
R70	RES, COMP, 1K+/-5%, 1/4W	148023	01121	CB1025	REF		
R71	RES, MTL FLM, 10K+/-1%, 1/8W	168260	91637	MFF1-81002F	1		
R72	RES, COMP, 510+/-5%, 1/4W	218032	01121	CB5115	REF		
R73	RES, COMP, 1K+/-5%, 1/4W	148023	01121	CB1025	REF		
R75	RES, COMP, 1K+/-5%, 1/4W	148023	01121	CB1025	REF		
R81	RES, COMP, 3.3K+/-5%, 1/4W	148056	01121	CB3325	REF		
R86	RES, COMP, 1.6K+/-5%, 1/4W	266197	01121	CB1625	1		
R87	RES, COMP, 2K+/-5%, 1/4W	202879	01121	CB2025	1		
R88	RES, COMP, 200+/-5%, 1/4W	193482	01121	CB2015	REF		
R89	RES, COMP, 3.3K+/-5%, 1/4W	148056	01121	CB3325	REF		
R91	RES, COMP, 51+/-5%, 1/4W	221879	01121	CB5105	REF		
T1	TRANSFORMER	299594	89536	299594	6		
T2	TRANSFORMER	299594	89536	299594	REF		

Table 609-11. Multi-Strobe Isolated Logic PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
T3	TRANSFORMER	299594	89536	299594	REF		
T4	TRANSFORMER	299594	89536	299594	REF		
T5	TRANSFORMER	299594	89536	299594	REF		
T6	TRANSFORMER	299594	89536	299594	REF		
U1	IC, TTL, HEX INVERTER	292979	01295	SN7404N	3	1	
U2	IC, TTL, 4 BIT RIGHT/LEFT SHIFT REG.	342691	01295	SN7495AN	3	1	
U3	IC, TTL, 4 BIT RIGHT/LEFT SHIFT REG.	342691	01295	SN7495AN	REF		
U4	IC, TTL, 4 BIT RIGHT/LEFT SHIFT REG.	342691	01295	SN7495AN	REF		
U5	IC, TTL, MSI 8-BIT SHIFT REGISTER	293118	01295	SN74165N	2	1	
U6	IC, TTL, MSI, SYN 4-BIT UP/DWN CNTRS.	293183	01295	SN74193N	1	1	
U7	IC, TTL, HEX INVERTER	292979	01295	SN7404N	REF		
U8	IC, TTL, MSI 8-BIT SHIFT REGISTER	293118	01295	SN74165N	REF		
U9	IC, TTL, 3-IN POS NAND GATES	292995	01295	SN7410N	2	1	
U10	IC, TTL, MSI, RETRIG MONO MULTIVBRTR	293134	04713	MC8601P	2	1	
U11	IC, TTL, QUAD 2-IN NAND GATE	292953	01295	SN7400N	4	1	
U12	IC, TTL, QUAD 2-IN NAND GATE	292953	01295	SN7400N	REF		
U13	IC, TTL, QUAD 2-IN NAND GATE	292953	01295	SN7400N	REF		
U14	IC, TTL, DUAL HI/SPEED, AND/OR INVERT	293084	01295	SN74H51N	1	1	
U15	IC, TTL, J-K EDGE TRIG F/F	293092	01295	SN74H102N	1	1	
U16	IC, TTL, HEX INVERTER	292979	01295	SN7404N	REF		
U18	IC, TTL, MSI, RETRIG MONO MULTIVBRTR	293134	04713	MC8601P	REF		
U19	IC, TTL, DUAL RETRIG MONO MULTIVBRTR	310235	01295	SN74123N	1	1	
U20	IC, TTL, QUAD 2-IN NAND GATE	292953	01295	SN7400N	REF		
U21	IC, TTL, HEX INVERTER	293076	01295	SN74H04N	1	1	
U24	IC, TTL, 8-BIT SHIFT REGISTER	272138	12040	DM8570	3	1	
U25	IC, TTL, 8-BIT SHIFT REGISTER	272138	12040	DM8570	REF		
U26	IC, TTL, 8-BIT SHIFT REGISTER	272138	12040	DM8570	REF		
U27	IC, TTL, DUAL FOUR-BIT LATCH	293191	04713	MC8303P	1	1	
U28	IC, TTL, MONO MULTIVIBRATOR	293050	01295	SN74121N	2	1	
U29	IC, TTL, J-K MSTR SLAVE F/F	296491	01295	SN7472N	1	1	
U30	IC, TTL, MONO MULTIVIBRATOR	293050	01295	SN74121N	REF		

For usage on Models 4210 and 4216 only. See Table 609-11A for timing components used on the Models: 4250, 4265, 4270 and 4275 for R19, R40, C11 and C20 Ref. Des.

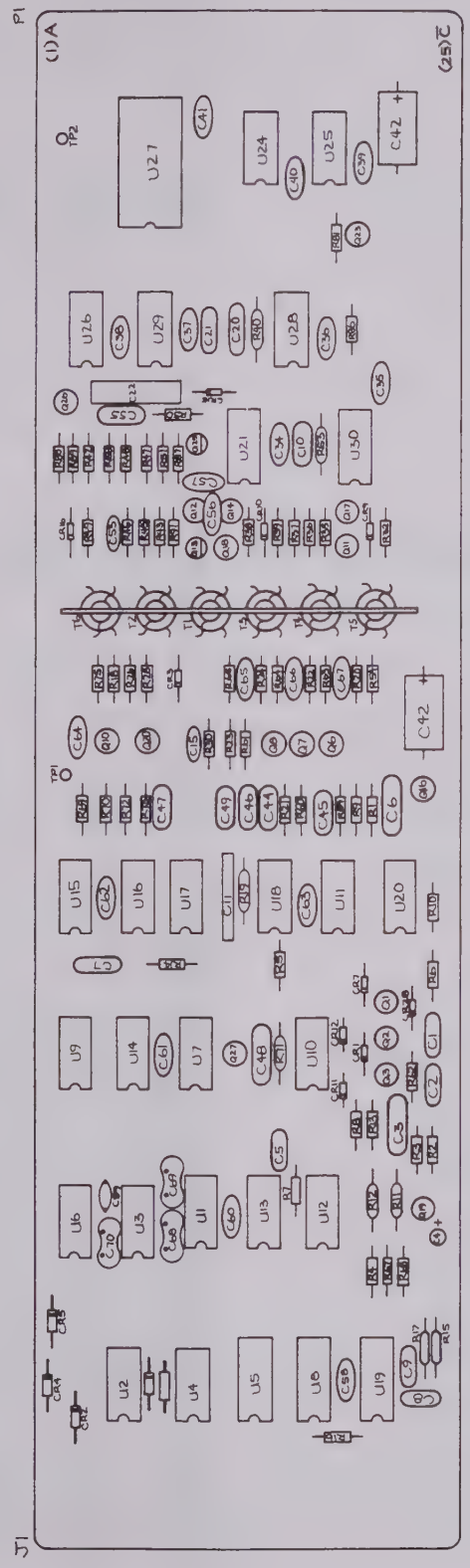


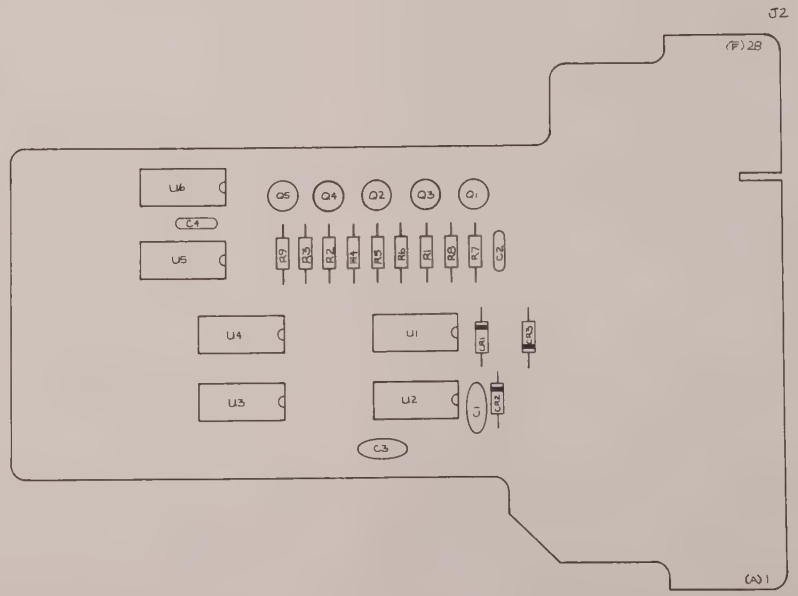
Figure 609-12. Multi-Strobe Isolated Logic PCB Assembly

Table 609-11A. Timing Components: 4250A, 4265A, 4270A, 4275A

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
C11	CAP, POLY STYRN, 0.01 UF +/-2%, 150V	168385	02799	PE103G	1		
C20	CAP, MICA, 680 PF +/-1%, 500V	226159	72136	DM19F681F	1		
R19	RES, MTL. FILM, 32.4K +/-1%, 1/8W	182956	91637	CMF553242F	1		
R40	RES, MTL. FILM, 31.6K +/-1%, 1/8W	261610	91637	CMF553162F	1		

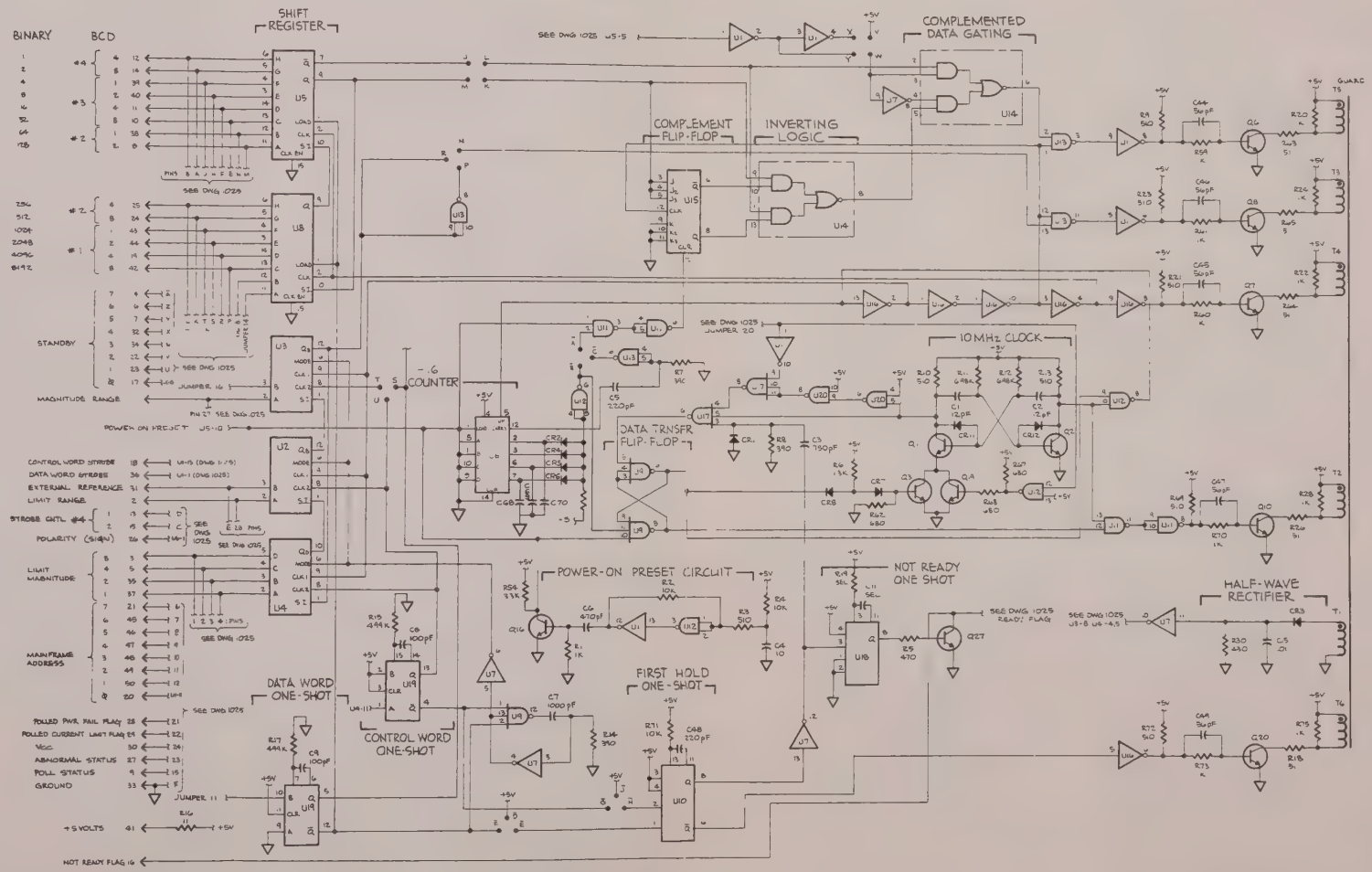
Table 609-12. 4200-09 Isolated Logic Piggyback PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	ISOLATED LOGIC PIGGY BACK PCB ASSY. FIGURE 6-13	341222	89536	341222			
C1	CAP, MICA, 330PF +/-5%, 500V	148445	72136	DM15F331J	2		
C2	CAP, CER, 0.22PF+/-5%, 50V	309849	32897	8131-050-651-224M	2		
C3	CAP, MICA, 330PF+/-5%, 500V	148445	72136	DM15F331J	REF		
C4	CAP, CER, 0.22PF+/-5%, 50V	309849	32897	8131-050-651-224M	REF		
CR1	DIODE, SI, 150 MA	203323	04713	1N4448	3	1	
CR2	DIODE, SI, 150 MA	203323	04713	1N4448	REF		
CR3	DIODE, SI, 150 MA	203323	04713	1N4448	REF		
Q1	XSTR, NPN, SI	159835	07910	CS23030	5	1	
Q2	XSTR, NPN, SI	159835	07910	CS23030	REF		
Q3	XSTR, NPN, SI	159835	07910	CS23030	REF		
Q4	XSTR, NPN, SI	159835	07910	CS23030	REF		
Q5	XSTR, NPN, SI	159835	07910	CS23030	REF		
R1	RES, COMP, 470+/-5%, 1/4W	147983	01121	CB4715	2		
R2	RES, COMP, 2K+/-5%, 1/4W	202879	01121	CB2025	1		
R3	RES, COMP 10K+/-5%, 1/4W	148106	01121	CB1035	4		
R4	RES, COMP 10K+/-5%, 1/4W	148106	01121	CB1035	REF		
R5	RES, COMP 10K+/-5%, 1/4W	148106	01121	CB1035	REF		
R6	RES, COMP 10K+/-5%, 1/4W	148106	01121	CB1035	REF		
R7	RES, COMP, 470+/-5%, 1/4W	147983	01121	CB4715	REF		
R8	RES, COMP, 20K+/-5%, 1/4W	221614	01121	CB2035	1		
R9	RES, COMP, 4.7K+/-5%, 1/4W	148072	01121	CB4725	1		
U1	IC, DTL, HEX INVERTER	268367	01295	SN15836N	1	1	
U2	IC, TTL, HEX INVERTER	292979	01295	SN7404N	2	1	
U3	IC, TTL, QUAD 2-IN NOR GATE	288845	01295	SN7402N	1	1	
U4	IC, TTL, QUAD 2-IN NAND GATE	292953	01295	SN7400N	1	1	
U5	IC, TTL, DUAL J-K F/F	293043	01295	SN74107N	1	1	
U6	IC, TTL, HEX INVERTER	292979	01295	SN7404N	REF		



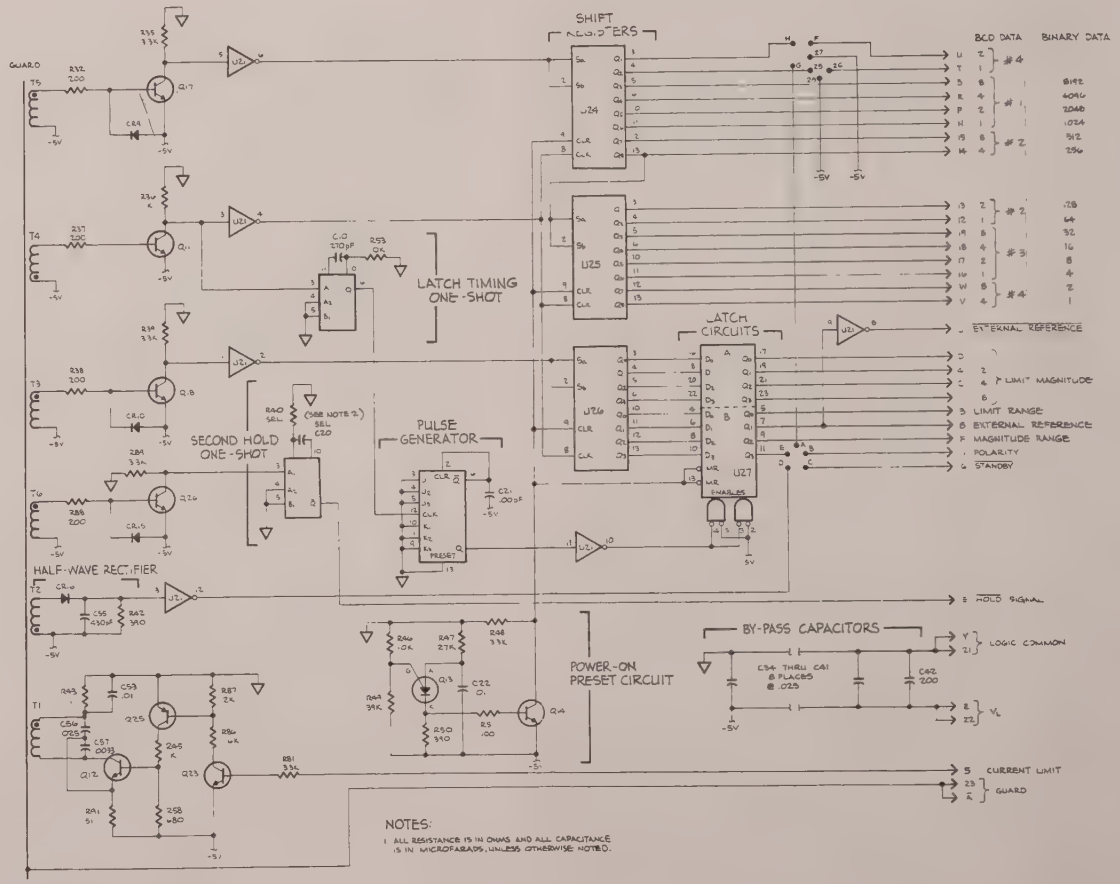
4200-1602

Figure 609-13. Isolated Logic Piggyback PCB Assembly



4200-1024
Sheet 1 of 2

Figure 609-14. Multi-Strobe Isolated Logic Board: Outside Guard



4200-1024
Sheet 2 of 2

Figure 609-14. Multi-Strobe Isolated Logic Board: Inside Guard (cont)

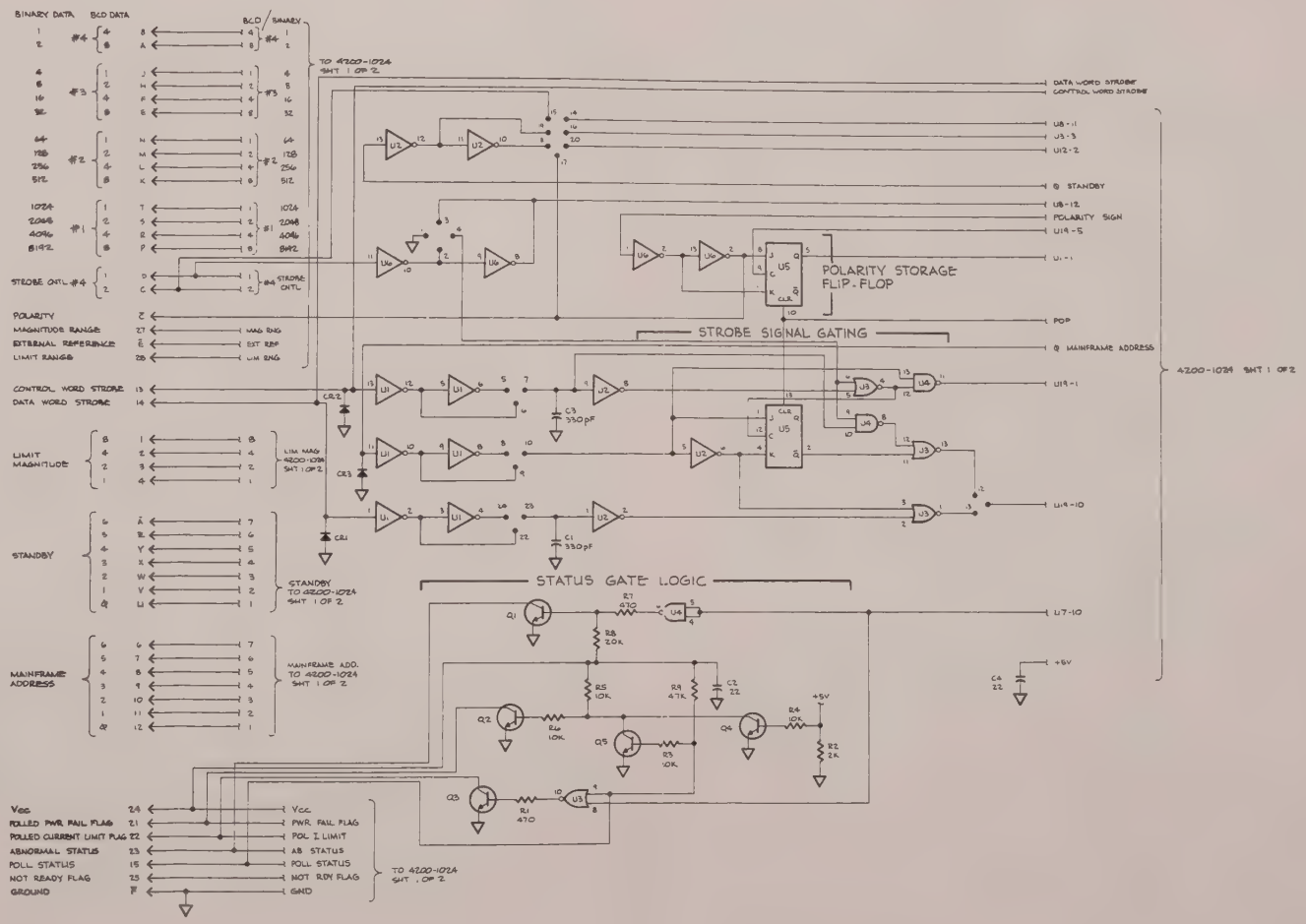


Figure 609-15. Multi-Strobe Isolated Logic Piggyback Board

Accessory

Model A4200

6-1. INTRODUCTION

6-2. The Model A4200 Manual Control Unit (MCU) with attaching interface cable and connectors is a manually operated program source for the 4200A series power sources. Figure 6-1 shows the MCU connected to a typical FLUKE power source. The purpose of the MCU is to permit an operator to fully exercise the programmable functions of any 4200A series power source, primarily for manual programming, calibration and adjustment, or for troubleshooting. Secondly, a synchronized oscilloscope display of a 4200A series power source output may be established and controlled with an MCU.

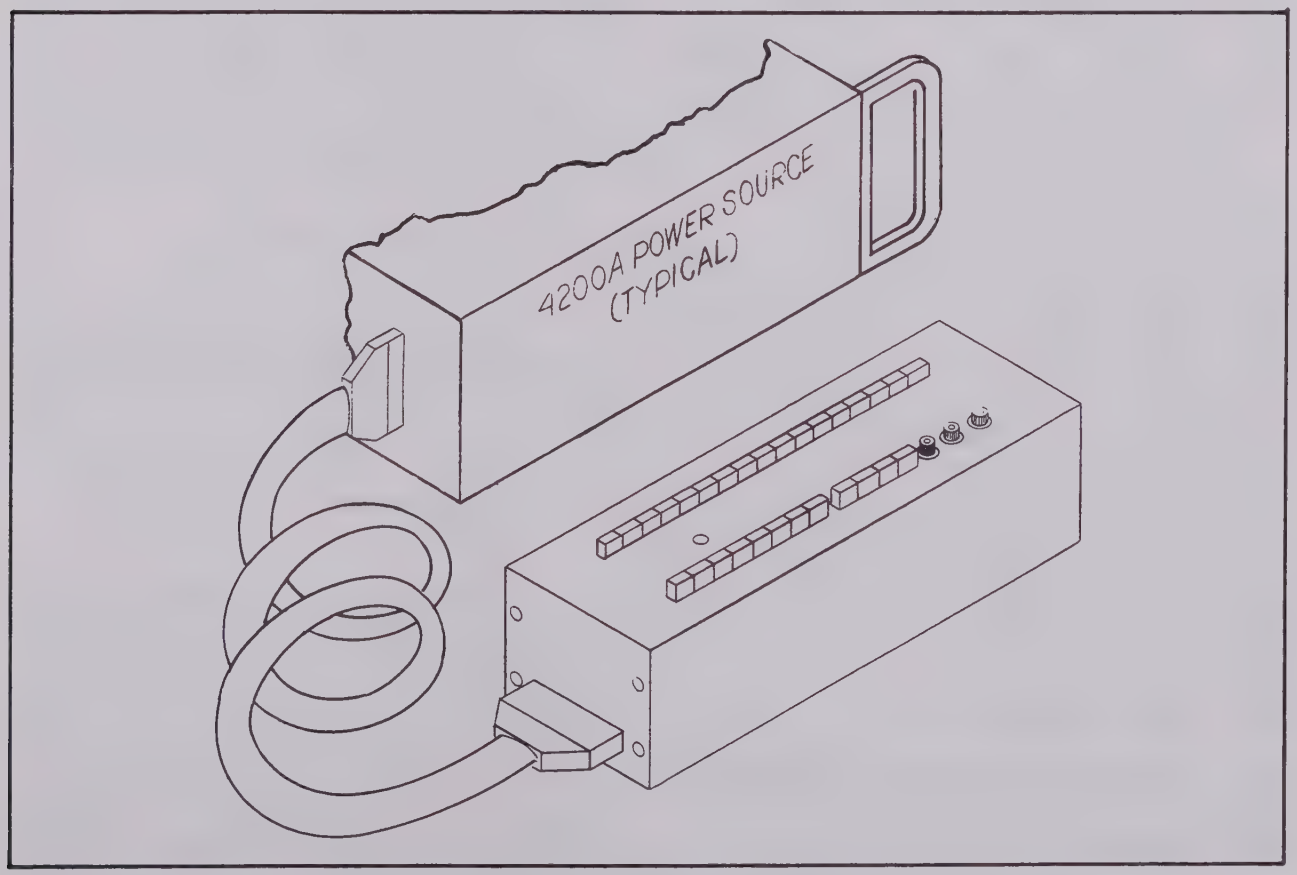


Figure 6-1. MODEL A4200 MANUAL CONTROL UNIT CONNECTED TO TYPICAL POWER SOURCE.

6-3. SPECIFICATIONS

6-4. There are no specifications for the Model A4200 MCU.

6-5. INSTALLATION

6-6. The MCU is supplied with an interface cable and connectors designed to fit any of the 4200A series power sources. The operating voltages for the MCU are supplied from the associated power source through the interface cable. The interface cable also supplies the power source with all programming inputs initiated by the MCU. Connection of the MCU to the power source via the interface cable is done as follows:

CAUTION!

The Model A4200 MCU is NOT compatible with the –09 option.

a. Turn off the power source and disconnect the programming connector from the rear panel of the power source.

b. Connect the interface cable connectors to both the programming connector on the power source and on the MCU.

c. Select the desired operating configuration on the top panel of the MCU and then turn on the power source. The power source is now ready for operation with the MCU.

6-7. OPERATING INSTRUCTIONS

6-8. The location and function of the MCU controls, indicators and connectors are described in Figure 6-2. The active or high level logic state of the pushbutton switches on the MCU is the depressed or *in* state. However, in the event the associated power source is equipped with the inverted logic option (08 Option), the logic level states of all pushbuttons defined below is high when the pushbuttons are extended or *out*. When depressed or *in*, the logic level state is low. This condition applies to all pushbuttons except STROBE, MANUAL, AUTO, and EXT. Figure 6-2 functionally describes the MCU controls, indicators, and connectors related to an associated power source that is not equipped with an –08 Option.

6-9. OPERATING FEATURES

6-10. The following paragraphs describe operating features relating the MCU to power sources and should be read prior to operating the MCU.

6-11. Isolated Control Logic (–01 Option)

6-12. The MCU provides the digital input programming, including the STROBE pulse, necessary to test and control an associated 4200A power source equipped with an isolated control logic option (–01 Option) or with an inverted isolated control logic option (–08 Option). When using either option, a STROBE pulse is required to start the digital-to-analog conversion process after a valid digital input program is entered. In MANUAL mode, the STROBE pulse is generated by manual depression of the STROBE pushbutton. In AUTO/EXTERNAL REFERENCE mode, the STROBE pulse is generated automatically following a 1.5μs delay that terminates the last programmed bit. The STROBE pulse is 0.5μ sec wide with a minimum width of 500 ns. A negative slope (+5V to 0 transition) is required.

6-13. Direct Coupled Control Logic (–04 Option)

6-14. Power sources using the direct coupled control logic option do not require use of the STROBE pulse. When used in the AUTO mode the performance is limited by the timing format of the STROBE pulse. Ideally, the STROBE pulse should precede the input data change and last until the input data is settled. The STROBE pulse, however, occurs about 1.5μs after the change of input data and lasts about 0.5μs. Consequently, voltage spikes may occur (going to 0 volts) when voltage levels are stepped. These spikes may be observed on an oscilloscope when monitoring the power source output and do not indicate a fault in the power source.

6-15. Coax Jack Cluster

6-16 Three BNC coaxial cable connectors located on the top panel of the MCU provide connections for test instruments. The common of these connectors is tied to logic ground.

6-17. Trigger Input

6-18. TRIGGER INPUT jack provides an input connection for an external trigger generator to produce a remote, manually controlled STROBE pulse when the MCU is in the AUTO EXT mode. The external trigger generator replaces a 10kHz multivibrator when the EXT pushbutton is depressed. An external 51Ω termination resistor is provided in the MCU for the external trigger generator. For optimum performance the trigger generator should have an output pulse impedance of 50Ω and be capable of producing the waveform shown in Figure 6-3.

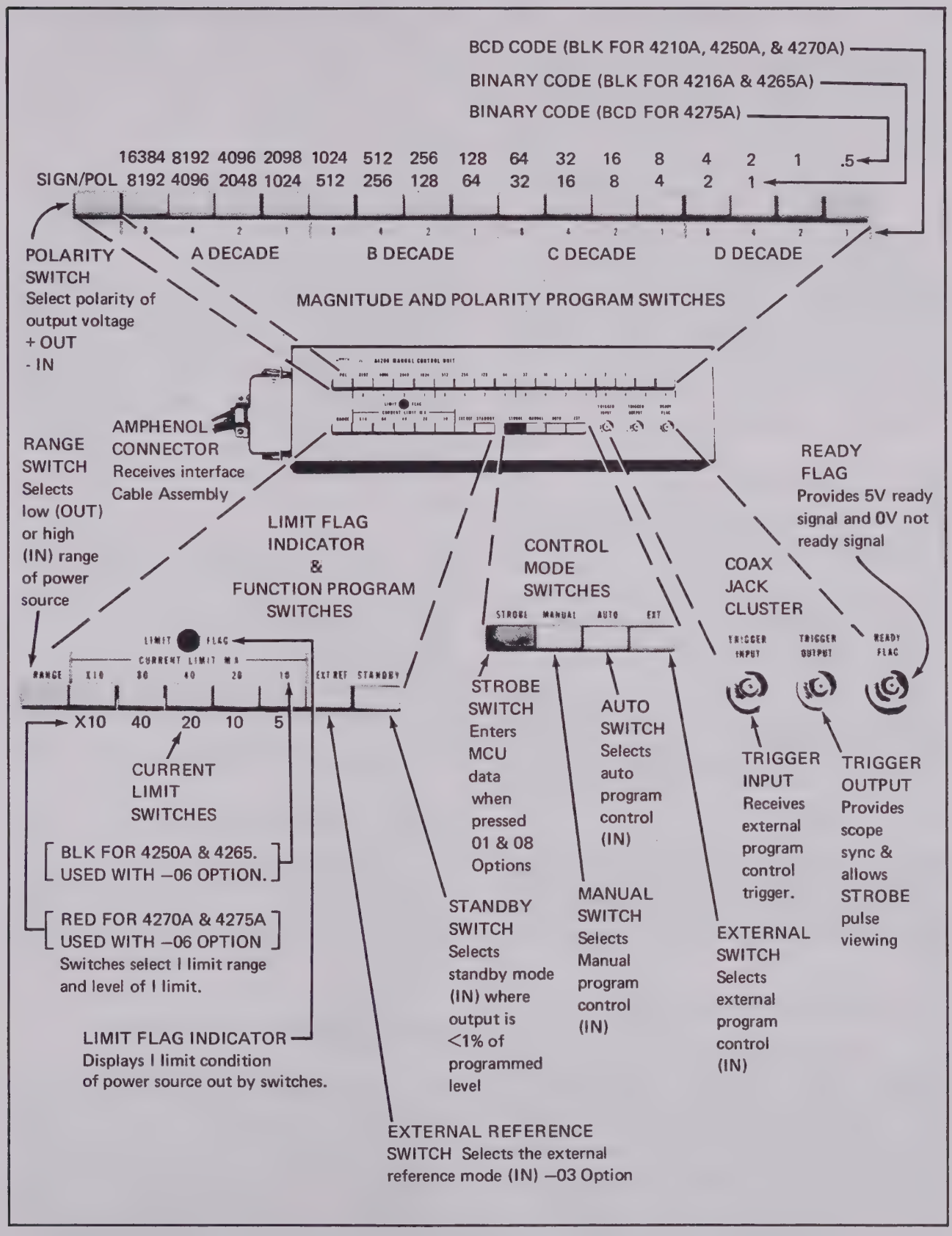

BCD CODE (BLK FOR 4210A, 4250A, & 4270A)
BINARY CODE (BLK FOR 4216A & 4265A)
BINARY CODE (BCD FOR 4275A)
16384 8192 4096 2098 1024 512 256 128 64 32 16 8 4 2 1 .5
SIGN/POL 8192 4096 2048 1024 512 256 128 64 32 16 8 4 2 1
A DECADE
B DECADE
C DECADE
D DECADE
POLARITY SWITCH
Select polarity of output voltage
+ OUT
- IN
MAGNITUDE AND POLARITY PROGRAM SWITCHES
AMPHENOL CONNECTOR
Receives interface Cable Assembly
RANGE SWITCH
Selects low (OUT) or high (IN) range of power source
READY FLAG
Provides 5V ready signal and 0V not ready signal
LIMIT FLAG INDICATOR & FUNCTION PROGRAM SWITCHES
CONTROL MODE SWITCHES
COAX JACK CLUSTER
STROBE MANUAL AUTO EXT
TRIGGER INPUT
TRIGGER OUTPUT
READY FLAG
LIMIT FLAG
CURRENT LIMIT MA
RANGE X10 40 20 10 5 EXT REF STANDBY
X10 40 20 10 5
CURRENT LIMIT SWITCHES
BLK FOR 4250A & 4265.
USED WITH –06 OPTION.
RED FOR 4270A & 4275A
USED WITH –06 OPTION
Switches select I limit range and level of I limit.
LIMIT FLAG INDICATOR
Displays I limit condition of power source out by switches.
STROBE SWITCH
Enters MCU data when pressed
01 & 08 Options
AUTO SWITCH
Selects auto program control (IN)
TRIGGER INPUT
Receives external program control trigger.
TRIGGER OUTPUT
Provides scope sync & allows STROBE pulse viewing
STANDBY SWITCH
Selects standby mode (IN) where output is <1% of programmed level
MANUAL SWITCH
Selects Manual program control (IN)
EXTERNAL SWITCH
Selects external program control (IN)
EXTERNAL REFERENCE SWITCH Selects the external reference mode (IN) –03 Option

Figure 6-2 CONNECTORS, CONTROLS, AND INDICATORS

CAUTION

Application of trigger voltages higher than the recommended value will damage the MCU.

①	DC OFFSET	–	±0.4	Vdc
②	AMPLITUDE	+2.8	+5.5	Vdc
③	WIDTH	0.5	–	μs
④	PRF	DC	10K	Hz
		MIN	MAX	UNITS
		LIMITS		

Figure 6-3. External Trigger Generator Requirements

6-19. Trigger Output

6-20. TRIGGER OUTPUT jack provides an output connection for monitoring the inverse of the MCU generated

STROBE pulse. The output trigger is a positive-going pulse that occurs each time a STROBE pulse is generated. It is useful in synching a scope to the MANUAL-STROBE mode. However, when using the AUTO or EXT modes, which generate an automatic internal or external STROBE, the output trigger provides a valid scope sync for the ready or not ready flag output only. It cannot be used to monitor the power source output voltage in the AUTO or EXT modes.

6-21. Ready Flag

6-22. READY FLAG jack provides an output connection for monitoring the ready or not ready flag voltage. In the three control modes (MANUAL, AUTO, or EXT) the output trigger provides a valid scope sync for displaying the flag voltage.

6-23. PROGRAMMING SWITCHES

6-24. Of the twenty-nine program switches located on the MCU top panel, all but three are used to enter programming inputs into the 4200A series power sources. These three are AUTO, MANUAL, and EXT. Figure 6-2 divides these switches into three groups of control mode switches, magnitude and polarity program switches, and function program switches.

6-25. Control Mode Switches

6-26. The four control mode switches provide manual or automatic control of the manually selected input data program. MANUAL, AUTO, or EXT are the three control modes selectable on the MCU.

6-27. Manual Mode

6-28. The MANUAL mode allows manual manipulation of the input programming data as well as manual generation of the STROBE pulse. This mode is selected by depressing the Manual pushbutton. Each push of the STROBE pushbutton generates a 0.5μs STROBE pulse which transfers the previously selected manual program to the internal registers of the isolated control logic option (–01 Option). In the event the power source is equipped with a direct coupled control logic option (–04 Option) rather than the isolated control logic option, the power source output voltage changes as the program pushbuttons are pressed. No STROBE is necessary.

6-29. Auto Mode

6-30. The AUTO mode of operation provides automatic and sequential scanning of a previously selected magnitude program. The power source output is thusly stair-stepped or pulsed in a manually selected pattern, the sequence of which is governed by an internal 10kHz multivibrator. The multivibrator also initiates the STROBE pulse for the isolated control logic option. If a direct coupled control logic option is used in lieu of the isolated control logic option in the associated power source, then the timing of the STROBE is incorrect.

6-31. External Mode

6-32. EXT mode operation is similar to the auto mode of operation. The difference is that the internal 10kHz multivibrator is switched out and an external pulse generator is substituted at the TRIGGER INPUT jack. The sequence frequency is thereby remotely controlled by the trigger generator.

6-33. Magnitude Program Switches

6-34. Sixteen magnitude program switches provided on the MCU are used to program the BCD or binary magnitude inputs into an associated power source. Each pushbutton is labeled with one or more bit values depending upon unit serialization. Units bearing serial No. 224 and below are labeled entirely in black. Units bearing higher serial numbers are labeled in black and red. The red coding applies to (1) the binary magnitude used to program the 4275A power

source, and (2) to the current magnitude used to program the current limit option (when installed) in the 4270A and 4275A power sources. The black coding applies to both binary and BCD magnitude power sources with the location and format of the magnitude bits identifying related power source effectivity as follows: The black binary magnitude bits above the pushbuttons apply to the 4216A and 4265A power sources. The black BCD magnitude bits below the pushbuttons apply to the 4210A, 4250A, and 4270A power sources. In MANUAL mode the magnitude inputs are programmed directly by depressing a single or combination of magnitude pushbuttons. In AUTO mode an internal binary counter controls the manually selected magnitude inputs in a four-bit binary pattern. Each output of the binary counter is parallel connected to the four corresponding BCD or binary magnitude programming switches shown in Table 6-1. The power source input program is sequenced in a pattern that is determined by the selected magnitude program switches and the binary counter outputs. Figure 6-4 shows the power source output voltage patterns available by programming a single decade in the 4210A, the 4250A, or the 4270A power source.

6-35. Polarity or Sign/Polarity

6-36. The polarity program for the power sources is controlled by the program switch marked POL or SIGN/POL. Depressing this switch commands the negative programmed output voltage. The non-depressed or *out* position commands the positive programmed output voltage.

6-37. External Reference

6-38. The EXT REF switch, when depressed, programs the External Reference Option (–03 Option) of the 4200A series power sources.

6-39. Standby

6-40. The STANDBY switch, when depressed, programs the 4200A series power sources to the standby condition. This condition permits a single bit on a given control line to clear the output to about 1 percent of the programmed level without disturbing the previous command word. Upon returning to the operational condition by releasing the STANDBY pushbutton, the output reverts to the pre-programmed level.

6-41. Range

6-42. When the RANGE switch is depressed, the high range of the associated power source is programmed. When not depressed and in the *out* position, the RANGE switch programs the low range of the power source. The low and high ranges of the 4200A series power sources are given in Table 6-2.

6-43. Current Limit

6-44. The five CURRENT LIMIT MA switches labeled in black or in black and red numbers, depending upon serial No. effectivity, program the Programmable Current Limit Option (–06 Option) in the 4250A, 4265A, 4270A, and 4275A power sources. The black numbered pushbuttons are used with the 4250A and 4265A power sources and the red numbered pushbuttons are used with the 4270A and 4275A power sources. Pushbutton switches labeled in black enable selection of the desired current limit point in increments of 10mA low range or 100mA high range (X10) for the 4250A and 4265A power sources (Table 6-3). The red labeled pushbutton switches enable selection of the desired current limit point in increments of 5 mA low range or 50 mA high range (X10) for the 4270A and 4275A (Table 6-4). When none of the pushbuttons are depressed, the current limit is 10 percent of selected range; i.e., 10 mA and 100 mA for the 4250A and 4265A; 5 mA and 50 mA for the 4270A and 4275A. The 4210A and 4216A power sources do not utilize the programmable current limit

TABLE 6-1
PROGRAMMING SWITCHES CONTROLLED BY THE BINARY COUNTER.

Binary Counter outputs	PROGRAMMING SWITCHES		
	4210A-4250A	4216A-4265A	4270A-4275A
1	1,1,1,1	4, 64,1024	.5, 8, 128, 2048
2	2,2,2,2	8,128,2048	1, 16, 256, 4096
4	4,4,4,4	1,16,256,4096	2, 32, 512, 8192
8	8,8,8,8	2,32,512,8192	4, 64, 1024, 16384

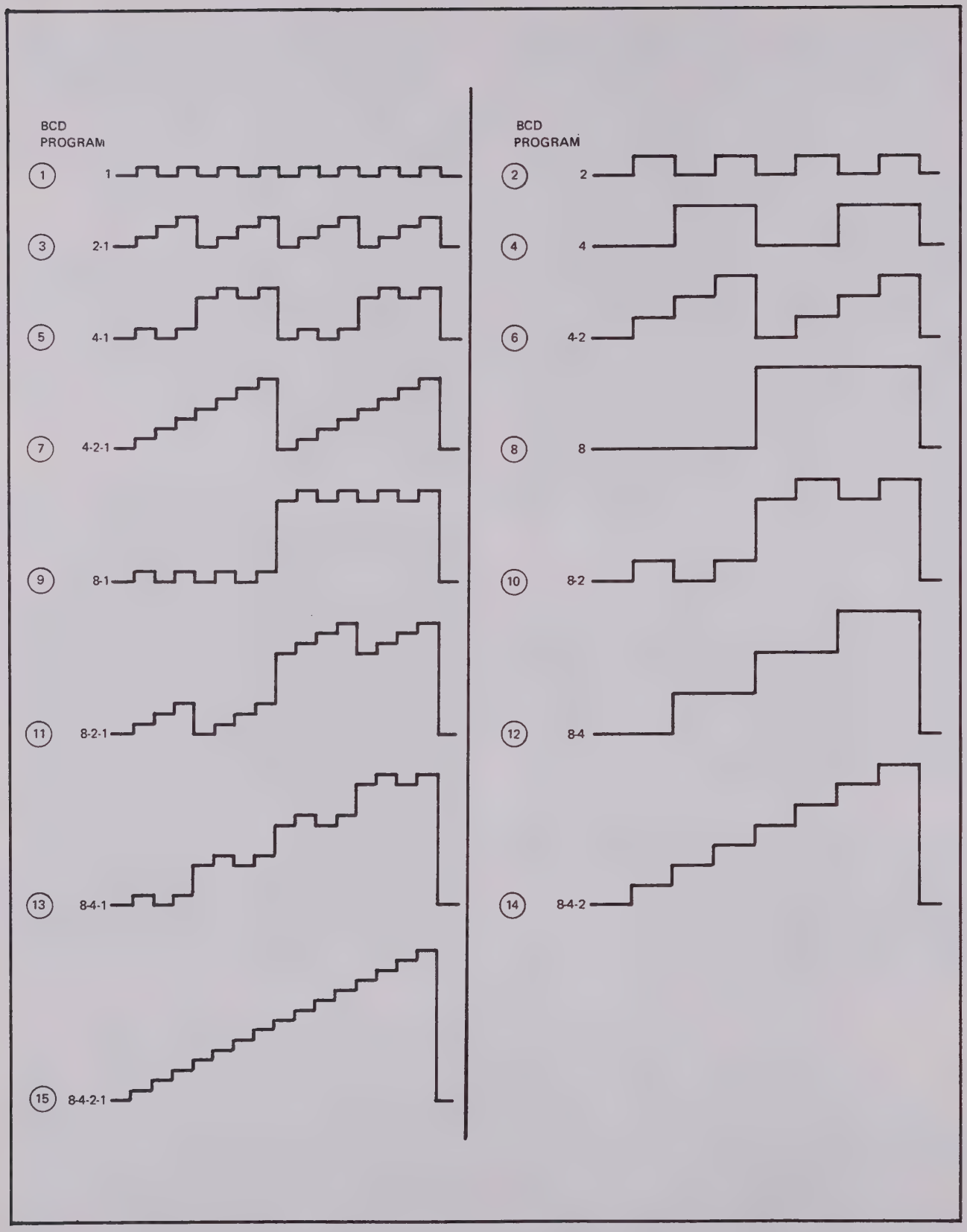


Figure 6-4. VOLTAGE PATTERNS OBTAINABLE BY DECADE PROGRAMMING IN THE AUTO MODE (4210A, 4250A, AND 4270A)

TABLE 6-2. 4200A SERIES INSTRUMENT RANGES

RANGE		INSTRUMENT								
PUSH-BUTTON	STATE	4210A 4216A	4250A		50 VOLT RANGE INDICATOR	4265A	65 VOLT RANGE INDICATOR	4270A	110 VOLT RANGE INDICATOR	4275A	110 VOLT RANGE INDICATOR
OUT	LOW	16V	BCD 10V	BINARY 16V	OFF	16V	OFF	10V	OFF	32V	OFF
IN	HIGH	16V	65V	65V	ON	65V	ON	X10	ON	X4	ON

TABLE 6-3. CURRENT LIMIT PROGRAMMING WITH –06 OPTION

4250A • 4265A CURRENT LIMIT MA PUSHBUTTON(S) DEPRESSED	RANGE (mA)	
	LOW	X10
NONE	10	100
10	10	100
20	20	200
20 • 10	30	300
40	40	400
40 • 10	50	500
40 • 20	60	600
40 • 20 • 10	70	700
80	80	800
80 • 10	90	900
80 • 20	100	1000
INCREMENTAL CHANGE	10	100
• AND CURRENT LIMIT WITHOUT –06 OPTION IS 1200mA		

TABLE 6-4. CURRENT LIMIT PROGRAMMING WITH –06 OPTION

4270A • 4275A CURRENT LIMIT MA PUSHBUTTON(S) DEPRESSED		RANGE (mA)	
RED	BLACK	LOW	X10
NONE	NONE	5	50
5	10	5	50
10	20	10	100
10 • 5	20 • 10	15	150
20	40	20	200
20 • 5	40 • 10	25	250
20 • 10	40 • 20	30	300
20 • 10 • 5	40 • 20 • 10	35	350
40	80	40	400
40 • 5	80 • 10	45	450
40 • 10	80 • 20	50	500
INCREMENTAL CHANGE		5	50
• AND CURRENT LIMIT WITHOUT –06 OPTION IS 600mA			

option, but do have a basic current limit of 100 mA. The basic current limit of the 4250A and 4265A power sources when not using the current limit option is 1.2 amp and, similarly, for the 4270A and 4275A is 0.6 amp.

6-45. Front Panel Indicator

6-46. The indicator labeled LIMIT FLAG on the MCU top panel is illuminated when a current overload (sink or source) condition occurs in the associated power source.

6-47. THEORY OF OPERATION

6-48. General

6-49. The A4200 MCU contains manually controlled switching circuits, internal, fixed-frequency triggered switching circuits, and provisions for externally controlled, variable frequency triggered switching circuits that provide the logic signals to control an associated programmable power source. These switching circuits permit manual control of the power source output voltage as well as an automatically triggered, repetitive and manually variable program for controlling the power source output voltage. The MCU is also provided with input-output circuits that, with the aid of a supplemental scope, permit the visual presentation of the ready or not ready status of the power source, the trigger output signal, and a means of connecting an external trigger.

6-50. Block Diagram Analysis

6-51. A simplified block diagram of the MCU is shown in Figure 6-5. The primary function of the MCU is to pro-

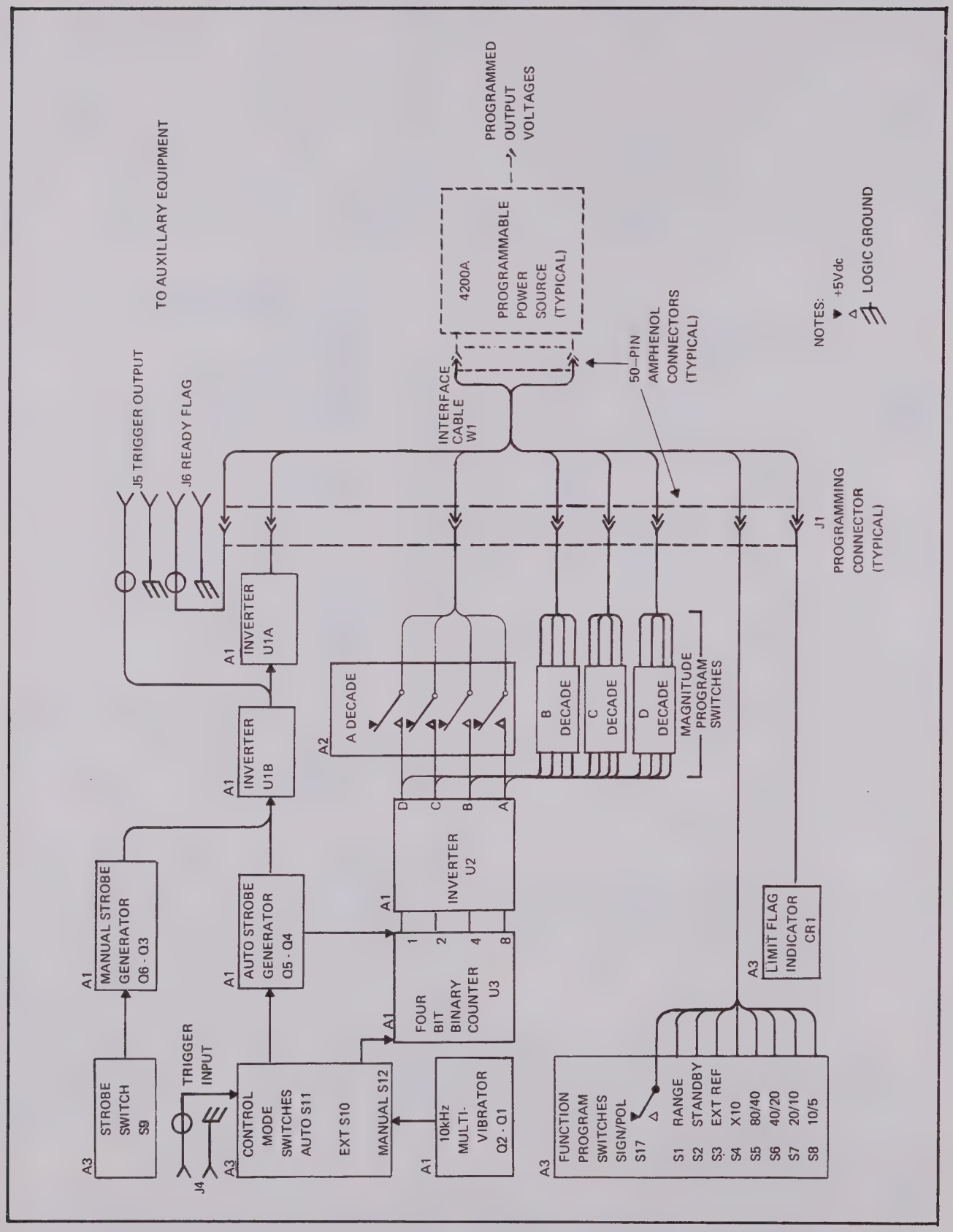


FIGURE 6-5. A4200 MANUAL CONTROL UNIT BLOCK DIAGRAM

vide manual control of the programming inputs into the 4200A series power sources. Switching by the following groupings of switches accomplishes this purpose: control groupings of switches accomplishes this purpose: control mode switches, magnitude program switches, and function program switches. The secondary function of the MCU is to provide an automatic mode of operation that applies a manually selected and manually variable magnitude program repetitively at a fixed or variable rate to a power source. This is accomplished by the following: a 10kHz oscillator, the control mode switches, and a 4-bit binary counter. The manual and auto strobe generators provide control of the strobing pulse for both the manual and automatic modes of operation.

6-52. With manual mode selected by A3 control mode switch S12, the four-bit counter is supplied with a logic 0 (low). This sets all four outputs of the counter to a logic 1 (high). Inverter U2 reverses the logic 1 on all four counter output lines to a logic 0, and then applies them in parallel through all closed magnitude program switches to the programmable power source via the interface cable and programming connectors. However, before the power source can act on the logic levels present on each of the 16 data lines, a logic level 0 manual strobe pulse must be entered. This is accomplished by manual depression of the strobe pushbutton switch S9, applying a logic 1 to the manual strobe generator Q6-Q3, which, in turn, supplies a logic 0 to inverter U1B. The dual inversion of inverters U1B and U1A then supplies the programmable power source with a logic 0 and the programmed output voltage appears at the output of the power source when the power source is equipped with the isolated control logic option.

6-53. With auto mode selected by A3 control mode switch S11, the previously selected manual mode switch is disconnected through interlock action. This removes the logic 0 applied to the set lines of binary counter U3. Simultaneously, the 10kHz multivibrator output is applied to two places: to the clock input of binary counter U3 and to the input of the auto strobe generator, Q5-Q4. The 10kHz multivibrator input to the binary counter U3 clocks it low initially and triggers the repetitive waveform pattern shown in Figure 6-6. The multivibrator input to auto strobe generator Q5-Q4 produces a 10kHz strobe pulse at its output, approximately half a microsecond wide, that is negative going, descending from +5 to OVdc. The pulse is inverted once through inverter U1B, to be used as a trigger output pulse at J5, and is inverted a second time through inverter U1A to be applied to the programmable power source via the interface cable W1 and programming connectors. The sequential output of the 10kHz driven binary counter is applied to the power source through any closed magnitude program switch in each decade following inversion through inverter U2.

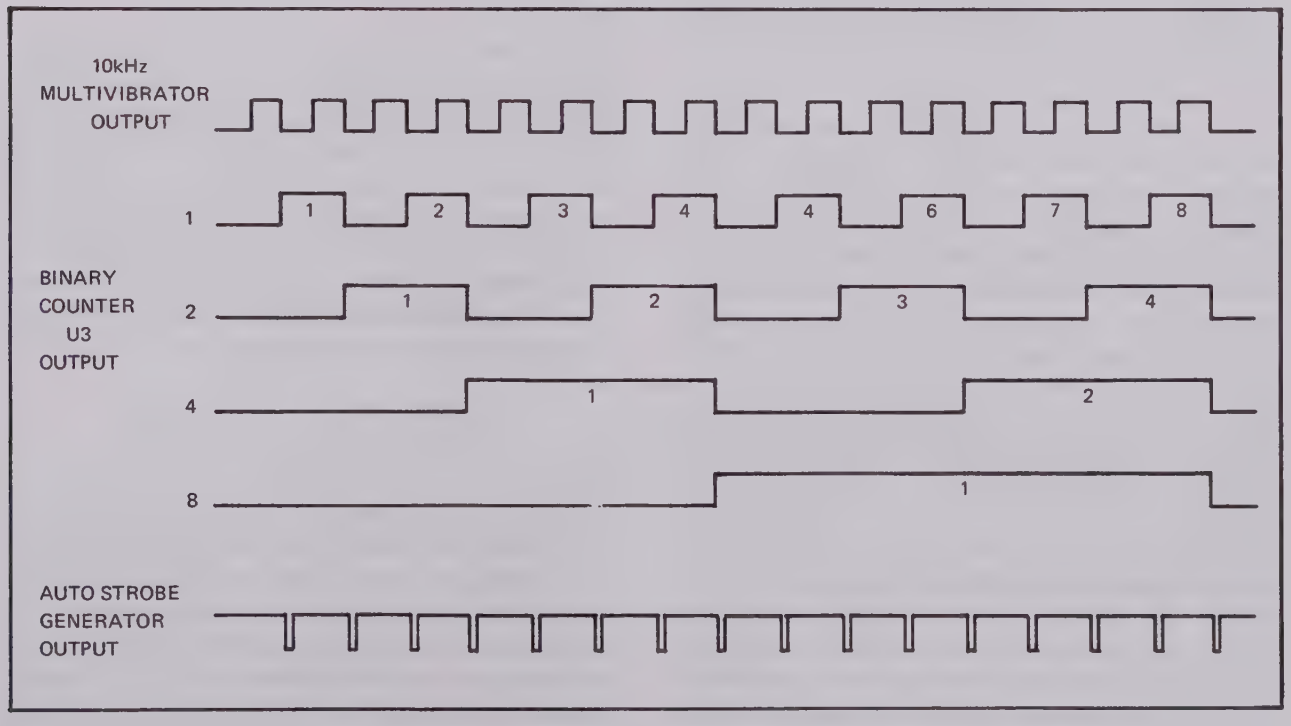


FIGURE 6-6. MODEL A4200 MCU TIMING DIAGRAM

6-54. With external mode selected by the A3 control mode switch, S10, the previously selected auto mode switch is disconnected through interlock action. This removes the 10kHz multivibrator output from the input to the binary counter and from the input to the auto strobe generator. Switched into these two input circuits is trigger input jack J4. Hence, use of an externally controllable trigger generator is possible, providing the parameters are generally as follows: output pulse frequency of 10kHz, 0.5μs pulse width, and having an output pulse impedance of about 50 ohms. The external trigger generator substitutes for the internal 10kHz multivibrator in the external mode, and circuit activity is essentially the same as discussed in auto mode.

6-55. The A3 function program switches provide a logic level low signal on the appropriate line to the connected power source when a given function switch is depressed. The SIGN/POL switch, S17, is shown as an example typical of these switches.

6-56. The indicator light LIMIT FLAG on the MCU top panel is essentially a duplication of the I LIMIT indicator on the front panel of a 4200A series power source. Hence, these two indicators can be expected to illuminate together when a specified current limit point is reached.

6-57. Circuit Description

6-58. The following paragraphs briefly describe the circuitry in the MCU. Each description, unless otherwise noted, is referenced to the schematic diagram A4200-1000 located at the end of this section.

6-59. CONTROL MODE SWITCHES. The control mode switches consist of three single pole, double-throw switches on the A3 Function Assembly, S10 through S12. These switches are the ganged, interlock, pushbutton type and only one switch at a time can be closed and latched. Switch S12, the MANUAL mode switch, when depressed and latched, applies a logic low (0 volts) to the four set input lines of the four-bit binary counter U3, pins 3,5,10, and 12. This forces the counter outputs on pins 4,6,9, and 11 to a logic high (5 volts). When the AUTO mode switch S11 is depressed and latched, the MANUAL mode switch is interlock released to its non-depressed state. This applies 5 volts to the binary counter previously held low by the latched, but now released MANUAL mode switch, and permits the counter to be advanced by the 10kHz multivibrator input at pin 1 of U3. The 10kHz MV output, supplied to the counter through the closed contacts of switch S11, is also applied to the input of the auto strobe generator at pin 9 of U1D. When the EXT mode switch S10 is depressed and latched, the AUTO mode switch is released. This removes the 10kHz MV output from the input of the auto strobe generator and from the clock input of the binary counter. The closed EXT mode switch connects the TRIGGER INPUT jack J4 to the counter and strobe generator inputs. An external 50 ohm pulse generator can be used to replace the 10kHz MV pulse. A 51 ohm resistor R1, provides the input termination for the external generator.

6-60. MAGNITUDE PROGRAM SWITCHES

6-61. The magnitude program switches consist of sixteen single pole, double-throw, push-push switches on the A2 Program Assembly, S1 through S16. The arms of these switches are wired directly to pins 1 through 16 of the J1 programming connector. The normally closed contacts of these switches are bussed to the 5Vdc power input, pin 25 of the programming connector. Hence, in their normally closed condition, which is the non-depressed state, these switches apply 5Vdc to pins 1 through 16 of the programming connector.

6-62. The normally open contacts of the switches are bussed in fours to one switch each in each of four groups, as S1 to S5 to S9 to S13, as S2 to S6, to S10, to S14, etc. In one case, these switches can be considered to be bussed in four BCD groups as determined by the weighting assigned each switch; i.e., 8, 4, 2, and 1. Thus, in the four decades, all similar weighted switches are paralleled on their normally open contacts.

6-63. Binary counter U3 supplies 1-2-4-8 logic levels through inverting gates U2D through A to the 1-2-4-8 switch busses, respectively. The logic levels are dependent on the state of the binary counter. In manual mode, the outputs of U3 are forced high (5 volts). Therefore, the outputs of the inventory gates supply a low (0 volts) to the switch busses. However, in auto or external mode, the switch busses are switched between high and low in a binary sequence and at a frequency determined by the 10kHz multivibrator, or by an external frequency applied at the trigger input jack J4.

6-64. FOUR-BIT BINARY COUNTER

6-65. The four-bit binary counter U3 is an asynchronous negative-edge triggered counter. The outputs (1-2-4-8) of the counter are connected to the correspondingly weighted busses of the sixteen magnitude program switches through the inverting gates of U2. The outputs of the counter are low at zero and go high in binary sequence. The clock required to advance the counter is supplied through the control mode switches by the 10kHz multivibrator, or by an

external pulse generator connected to trigger input jack J4.

6-66. TEN KILOHERTZ MULTIVIBRATOR

6-67. The 10kHz multivibrator is a simple, dual transistor (Q1-Q2) multivibrator designed to free run at approximately 10kHz. The square wave output is used in the auto control mode to clock the binary counter and to trigger the auto strobe generator.

6-68. AUTO STROBE GENERATOR

6-69. The A1 auto strobe generator is composed of transistors Q4-Q5 and inverter amplifiers U1A through U1E, plus related circuit components. It is an active pulse shaping network that is used to supply a strobe pulse in the auto and external modes of MCU operation. The negative descent of each 10kHz pulse from the 10kHz MV triggers the auto strobe generator. Following an approximate delay of 1.5 microseconds, a strobe pulse of half a microsecond, approaching 0 volts from a 5 Vdc reference, is produced at the input of inverter amp U1B. The output of U1B produces a positive-going pulse that is applied as a trigger at trigger output jack J5. Inverter amp U1A returns the strobe pulse to its original excursion and presents it at pin 33 of the programming connector.

6-70. MANUAL STROBE GENERATOR

6-71. The A1 manual strobe generator is composed of transistors Q6 - Q3, A3 control mode switch S9 (STROBE), and related circuit components. The manual strobe pulse generator is built around a programmable unijunction transistor (PUT) Q6 which is effectively anode gated by the application of a positive voltage through the momentary closed contacts of the STROBE pushbutton switch S9. The firing of Q6 turns on gating transistor Q3, which effectively applies a logic 0 pulse at the input of inverter amp U1B. Pulse processing through the two inverters, U1B and U1A, is the same as described in the previous paragraph.

6-72. FUNCTION PROGRAM SWITCHES

6-73. The function program switches consist of nine spot push-push switches (with one exception - the momentary contact STROBE switch S9) on the A3 Function Assembly, S1 through S9. The arms of these switches are wired directly to their corresponding pins on the J1 programming connector. These switches are independent and are not controlled by any other switches or any other circuitry, with the exception of the 5 volt 1ns line which is paralleled to the normally closed contacts of switches S1 through S8. Switch S9 is the opposite configuration with the 5 volt bus line tied to the normally open momentary contact. Switches S1 through S8, when depressed, latch to logic 0.

6-74. READY FLAG

6-75. Ready flag connector J6, mounted on the MCU top panel, produces an output of 5Vdc to indicate that the related power source is ready to accept programming inputs, or produces a 0 volt output to indicate that the power source is not ready to accept programming inputs. This output jack is tied directly to the power source through the interface cable and programming connectors on Pin 37.

6-76. LIMIT FLAG

6-77. Limit flag indicator CR1, mounted on the MCU top panel, is a red-light emitting diode. It illuminates when forward biased by a logic 1 (logic ground) on its cathode. A logic 1 is applied to the cathode from the programmable power source via the interface cable and programming connectors on Pin 49 when an overload (overcurrent) condition exists in the power source.

6-78. MAINTENANCE

6-79. Introduction

6-80. The maintenance procedures given in the following paragraphs describe maintenance access, pushbutton replacement, LIMIT FLAG indicator replacement, and troubleshooting.

6-81. Maintenance Access

6-82. Remove six Phillips Head screws from sides of channel bottom. Remove four Phillips Head screws securing rubber feet to bottom of unit.

6-83. Withdraw V-shaped channel bottom from MCU. Test points 1 through 5 are now accessible at bottom of unit on the component side of the motherboard, connector PCB Assembly.

6-84. Remove two Phillips Head screws from rear, left side of unit.

6-85. Remove motherboard, Connector PCB Assembly from the unit with a gentle rocking and pulling motion to separate motherboard from the two other PCB's in the unit.

6-86. Disconnect coaxial jack cluster connectors at the underside of the Function Assembly PCB. These four connectors may be colored BLK, RED, BRN and ORN.

6-87. Disconnect leads to LIMIT FLAG light emitting diode - also on the same PCB. These two leads may be colored ORN and YEL.

6-88. Remove two Phillips Head screws from the right side of the unit and two remaining screws from the left side of the unit.

6-89. Remove the switch panel from the MCU top panel. Each of the individual pushbutton switches are accessible for individual continuity checks. The upper switch bank is mounted on the Program PCB Assembly and the lower switch bank is mounted on the Function PCB Assembly. Prior to further disassembly, note the relationship of the program PCB and function PCB to the end flanges of the MCU top panel. Viewed from the rear, with program PCB uppermost, the cluster of four P-nuts must be on the right flange.

6-90. Removal of two Phillips Head screws from each of the ends of the program and function PCB's permit removal of these two boards with attached pushbutton switch banks.

6-91. Assembly of the MCU is done in reverse order of disassembly with attention to the proper locating of the program and function PCB's on the switch panel as noted in step 6-89. Reversal of these two PCB's is possible, but will not permit final assembly of the top panel.

6-92. Switch Maintenance

6-93. The following eleven paragraphs describe the procedure to be followed when a defective switch is to be replaced in the MCU.

6-94. Remove the PCB assembly that contains the defective switch using the maintenance access procedures given in the previous paragraphs.

6-95. Since individual pushbutton switches are not replaceable, an entire switch set that contains the defective switch must be replaced as a unit.

6-96. Refer to the List of Replaceable Parts to determine the FLUKE part number for the switch set to be replaced and order the switch set in conformance with part ordering instructions.

6-97. Following receipt of the correct replacement switch set, determine that it is operating correctly and then remove the switch set containing the defective switch as follows:

a. Using a small soldering iron and a solder removing tool, unsolder all of the switch set mounting tabs from the circuit board pads and remove as much liquified solder as possible with the solder removing tool.

b. Prevent adherence of the cooling tabs to the pads by vibrating each tab in its pad with a pair of needlenose pliers or a similar tool.

c. After all tabs are unsoldered from the PCB pads, remove the entire switch set from the PCB and exercise care to remove the PCB spacers that are attached to the switch tabs. Make a layout sketch of the positions of the spacers on the switch set.

d. Remove the spacers from the defective switch set and install them, each one on the new switch set in accordance with the layout sketch made in the previous step. Press the spacers tightly against the switches, cleaning out any flowed solder that prevents full surface contact between the spacers, switches, and PCB.

e. Insert the new switch set into the PCB in the same orientation as the adjacent switch set, top side up.

f. Solder all tabs into the PCB pads and be careful to press each switch tightly against the PCB. The installed switch set must be aligned with the adjacent switch set and with the PCB evenly, or else the switch assembly will not fit through the slots on the top panel at final assembly.

g. Check that the newly installed switch set is operating correctly and install the PCB into the MCU as defined under maintenance access.

6-98. Limit Flag Indicator Replacement

6-99. The following eleven paragraphs describe the procedure to be followed when a defective indicator is to be replaced in the MCU.

6-100. Refer to the List of Replaceable Parts to determine the FLUKE part number for the indicator to be replaced and order it in conformance with the part ordering instructions.

6-101. Install replacement indicator in the MCU as follows:

a. Perform maintenance access procedures to the step that removes the motherboard connector PCB Assembly from the MCU.

b. Locate insulating sleeving that covers one of the wires leading into the rear of the defective indicator and slide it back along the wire until the amp connector it covers is fully exposed. Observe color coding of wires for later hook-up.

c. With a long pointed soldering tool, unsolder the amp connector uncovered in the previous step from an indicator lead. Repeat with the other indicator lead and clean both amp connectors internally of any residual solder.

d. Using a blunt instrument or rod of sufficient diameter to clear the inside of the indicator retaining cup, push the indicator out the retaining cup from the rear. Observe orientation upon removal for later installation of replacement.

e. Using the removed indicator as a guide for the new indicator, clip the correct lead at the base and the other two leads to the proper length.

f. Insert the indicator into the cup in the same exact orientation as observed during removal of the defective indicator.

g. Connect both amp connectors identically to the earlier observed hook-up and solder connectors to the indicator leads using minimal heat and solder.

h. Slide the insulating sleeving over the amp connector to insulate the bare indicator leads from each other.

i. Assemble the MCU in accordance with procedures given under maintenance access.

6-102. TROUBLESHOOTING

6-103. The troubleshooting of an improperly responding and defective power source, when under control of an MCU, is not covered in this section. Troubleshooting the power source is covered, however, in the basic instrument maintenance section of the manual, and may not include use of the MCU as a troubleshooting aid. On the other hand, the first indication that troubleshooting is necessary will be an improperly responding power source that is under control of an MCU. Consequently, the first step in using these troubleshooting procedures is to determine that the MCU is faulty and not the associated power source.

6-104. The MCU and power source are tied together for one of three purposes: (1) for manual control of the programming inputs to a valid power source, (2) for calibration and adjustment of an out-of-tolerance or repaired power source, and (3) for troubleshooting an improperly operating power source. In the first two cases when malfunctions are observed in the response of the power source to MCU programming inputs, other than obvious mechanical faults on the MCU, such as a stuck switch, a bent or misaligned programming connector, or a servered cable wire - all of which are readily identified and repaired - isolation of the fault to the MCU is accomplished by disconnecting the MCU at the power source programming connector and connecting another programming source, known to be good, to the power source. In the third case where an MCU is used to troubleshoot an improperly operating power source and the MCU becomes suspect, the MCU must be considered defective and checked separately. A troubleshooting procedural outline is given on the reverse side of the foldout page which faces the schematic diagram of the MCU.

6-105. Equipment required for troubleshooting the MCU is a multimeter, an oscilloscope, and a 7-inch insulated shorting jumper terminated with midget alligator clips. Additionally, a 5 volt dc power supply is required for troubleshooting the MCU when it is disconnected from the power source.

6-106. With the interface cable attached and locked to the J1 programming connector on the MCU, gain access to the motherboard A1 Connector Assembly and locate test points 1 through 5. See maintenance access procedures, paragraph 6-81. Proceed with troubleshooting procedures given on drawing No. A4200-1800.

MODEL A4200

TROUBLESHOOTING PROCEDURES

Power Off Checks

1. Inspect MCU for improperly seated plug-in assemblies, loose or broken wires, damaged or burned components, or other obvious problems.

2. Check that switches are aligned and that no broken switch return springs are evident.

3. Check that connectors are properly attached to motherboard A1 Connector Assembly from coaxial jacks and from LIMIT FLAG indicator.

Power on Checks

1. Apply 5 Vdc to MCU in either of two ways to determine that power input and distribution circuits are continuous. Either apply power by connecting interface cable connector to power source and turning on power switch, or by locating test points 4 (+) and 3 (-) and applying +5Vdc to these test points from the and applying +5Vdc to these test points from the 5Vdc power supply.

2. If MCU is connected to a power source as defined above, check for +5Vdc between test points 4 (+) and 3 (-). If MCU is connected to the 5Vdc power supply at test points 4 (+) and 3 (-), check for +5Vdc between pin 25 (+) and any pin of the group number 17 through 24 (-) on the unconnected interface cable connector.

3. Failure to measure the required voltage at the places specified above indicates a defective interface cable/ connectors or a defective A1 motherboard A1 Connector PCB Assembly. Refer to the schematic diagram and localize the fault to either the interface cable/ connectors or to the A1 PCB, as appropriate.

   10kHz MULTIVIBRATOR CHECK. Check the output of the 10kHz multivibrator by measuring between test points 1 (+) and 3 (-) either with a multimeter set to 2.5Vdc for full scale deflection, or, if a waveform inspection is desired, connect the input of the scope to these test points and observe the square wave output as shown in Figure 6-6. If neither voltage nor waveform is present, the multivibrator may be locked up. In this case, remove power from the MCU and reapply as a step function to initiate flip-flop action of the multivibrator. Check output again, and, if none is observed, the multivibrator circuit is defective.

   MANUAL SWITCH, FOUR-BIT BINARY COUNTER, AND GATED INVERTER U2. Locate pins 9 through 12 on the rear of the interface cable connector attached to the A1 motherboard. Select one of the four pins for +5Vdc full scale deflection measurement on the meter. Use test point 3 (-) for ground reference. Depress and latch the C decade pushbuttons. Depress and latch the MANUAL pushbutton and check that the multimeter reads about 0Vdc. Check for 0Vdc on the other three pins. Release MANUAL and check that the multimeter reads +5Vdc on each pin. Failure to read any one voltage indicates that inverter U2 is probably defective. Failure to read all voltages indicates that the four-bit binary counter or MANUAL switch is probably defective. To isolate the MANUAL switch from the counter, proceed as follows: Confirm that 5Vdc exists on pin 9 at the rear of the interface cable connector attached to the A1 motherboard. Attach the shorting jumper between test points 1 and 2 and check that the multimeter reads less than the previous dc voltage. If less, then the MANUAL switch is probably defective. If dc voltage does not decrease after the shorting jumper is attached then the four-bit counter is defective. This condition can be confirmed by viewing absence of waveform on scope at pin 9 after the shorting jumper is attached.

   STROBE SWITCH, MANUAL STROBE GENERATOR, AND INVERTERS U1A–U1B. Connect oscilloscope input between pin 33 and test point 3. Set up scope for display of 0.5μs pulse (s) descending to 0 from +5Vdc. Depress STROBE pushbutton switch repeatedly and observe more than one decending pulse of the extent and magnitude given above. If no pulse is obtained, repeatedly attach shorting jumper between test points 4 and 5 and check scope for pulses. If pulses are obtained, STROBE switch is defective. If no pulses, take scope input from TRIGGER OUTPUT jack J5, and look for ascending pulses. If pulses are obtained, integrated circuit inverter U1A is defective. If no pulses are obtained either the manual strobe generator or the auto strobe generator is defective. To check the auto strobe generator, remove the previously attached shorting jumper and attach it between test points 1 and 2. Check for previously defined output pulse(s) from TRIGGER OUTPUT jack J5. If pulses are present, manual strobe generator is defective. If pulses absent, integrated circuit inverter U1B, which is part of the auto strobe generator, is defective.

AUTO STROBE GENERATOR AND AUTO SWITCH: The previous paragraph defined the procedures for checking part of the autostrobe generator that is common to the manual strobe generator. This paragraph gives the procedure for checking that portion of the auto strobe generator upstream of inverter U1B as well. Set up the scope as defined in first two sentences of the previous paragraph. Remove shorting jumper from test points 1 and 2 if previously attached. Depress and latch AUTO pushbutton on top panel of MCU. Check for repeated pulses as defined above. If pulses are present, the circuitry from the 10kHz multivibrator to AUTO switch to auto strobe generator to output at pin 33 is valid. If pulses are not present, determine from a previous paragraph that 10kHz multivibrator is valid and then apply the shorting jumper between test points 1 and 2. If pulses are present, the AUTO switch is defective. If pulses are absent, the auto strobe generator is defective. To determine which pulse forming stage in the pulse generator is defective, refer to the schematic and, using the scope, check each stage regressively from the base circuit of transistor Q4 until a waveform synched to 10kHz is found. This point defines the input to the defective stage.

SWITCHES AND INDICATOR: Troubleshooting of the pushbutton switches and indicator is done using a multimeter for either continuity or volrage checks.

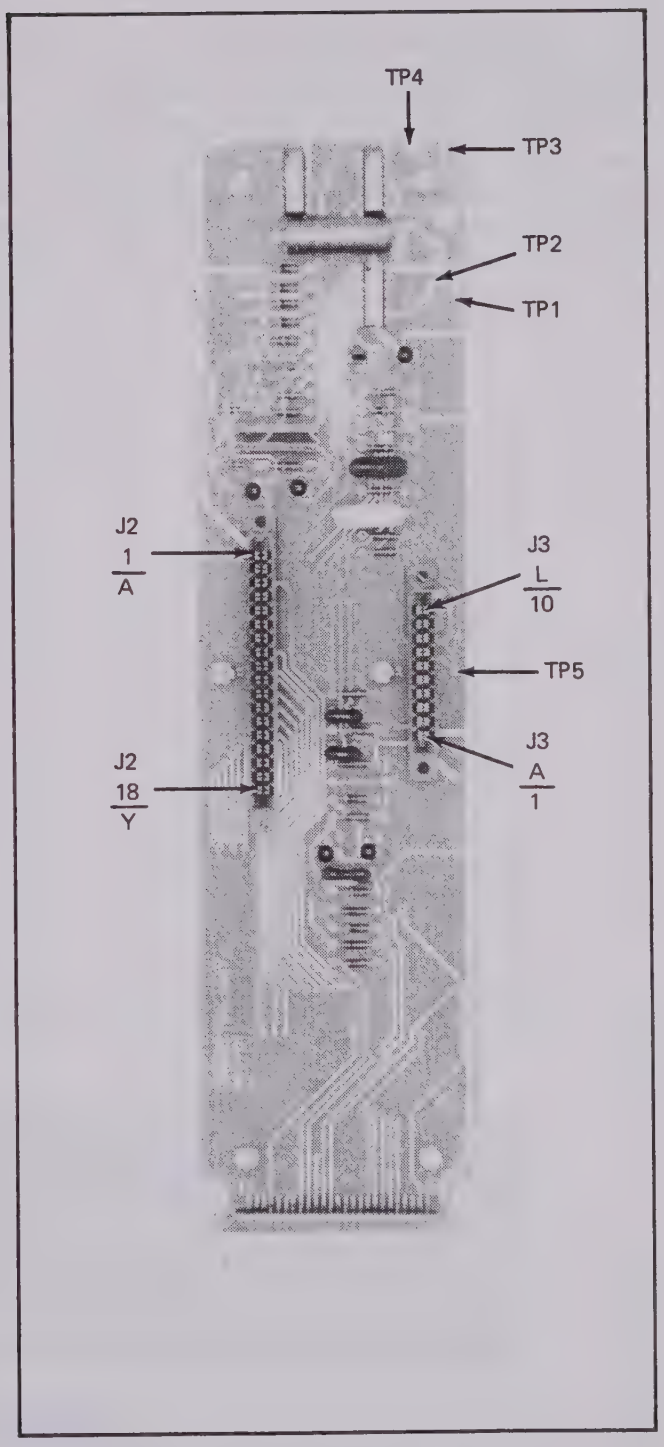


Figure 6-7. MOTHER BOARD A1
CONNECTOR ASSEMBLY PCB

6-107. LIST OF REPLACEABLE PARTS

6-108. For column entry explanations, part ordering information and basic instrument configuration Use Codes and Serial Number Effectivity List, see Section 5. See paragraph 6-109, this option subsection, for additional Use Codes and Serial Number Effectivity List assigned to this printed circuit assembly option.

6-109. SERIAL NUMBER EFFECTIVITY

6-110. A Use Code column is provided to identify certain parts that have been added, deleted, or modified during production of the Model A4200. Each part in this option for which a use code has been assigned may be identified with a particular serial number by consulting the Use Code Effectivity List below. All parts with no code are used on all serial numbers 123 and on. NOTE: These Use Codes and Serial Number Effectivity apply to this option only.

USE CODE	SERIAL NUMBER EFFECTIVITY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
	MANUAL CONTROL UNIT (Figure 6–8)	A4200			
A1	CONNECTOR ASSEMBLY, PCB Figure 6-9.	303701	1		
A2	PROGRAM SWITCH ASSEMBLY, PCB Figure 6-10.	303727	1		
A3	FUNCTION ASSEMBLY, SWITCH PCB Figure 6-11.	303719	1		
	PANEL, TOP, SCREENED Figure 6-8.	303743	1		
	Connector, BNC, level cont. input.	152033	3		
CR1	Diode, Light Emitting	309617	1		
W1	Cable Assembly, Interface	303354	1		
XCR1	Clip, Snap-in, (diode) black	309625	1		
	Panel Switch (Panel Switch (interior)	303768	1		
	Foot, Rubber Button, black	130138	4		
	Channel, bottom	303750	1		
	Switch Assemblies (see A2/Figure 6-9. and A3/Figure 6-10.)				

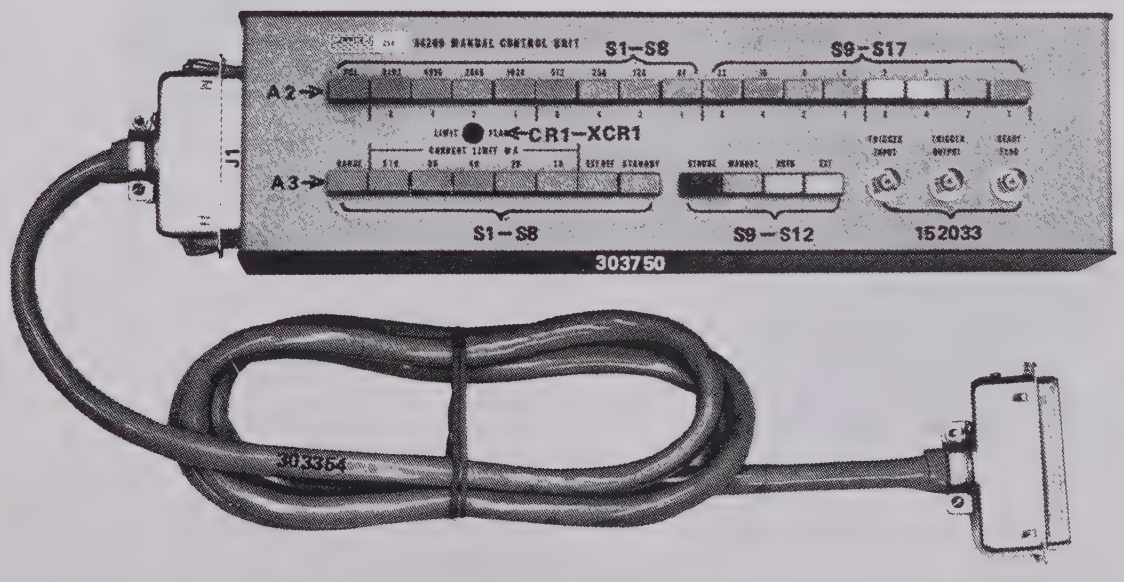
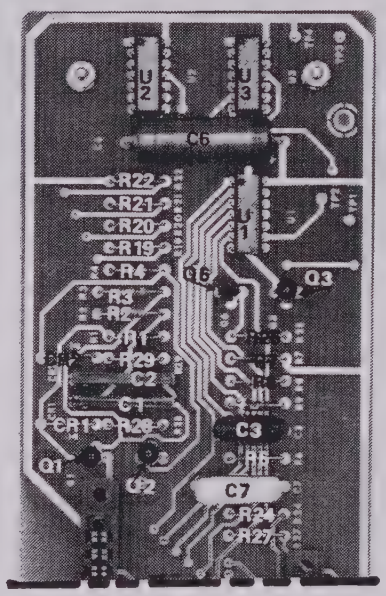


Figure 6-8 MANUAL CONTROL UNIT

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A1	**CONNECTOR ASSEMBLY, PCB Figure 6–9.**	REF			
C1,C2	Cap, fxd flm, .0047 uf ±2% 150v	182972	2		
C3	Cap, plstc .047 uf ±10%, 200v	207555	1		
C4	Cap, mica, 330 pf ±5%, 500v	148445	1		
C5	Cap, mica, 100 pf ±5%, 500v	148494	1		
C6	Cap, fxd, elect, 640 uf + 50/–10%, 6.4v	178608	1		
C7	Cap, plstc, .47 uf ±10%, 250v	184366	1		
C8	Cap, mica, 640 pf ± 5%, 500v	215251	1		
CR1,CR2	Diode, sil, 150 ma	203323	2		
J1	Connector, female, 50 contact	267252	1		
J2	Connector, female, 36 contact	285247	1		
J3	Connector, female, 20 contact	292912	1		
Q1 thru Q5	Xstr, Si, NPN	159855	5		
Q6	Xstr, Si, unijunction	268110	1		
R1,R4,R28, R29	Res, comp, 2.4K ±5%, 1/4w	193433	4		
R2,R3	Res, met flm 15.4K ±1%, 1/8w	261651	2		
R5	Not used				
R6	Res, comp, 22K ±5%, 1/4w	148130	1		
R7	Res, comp, 10K ±5%, 1/4w	148106	1		
R8	Res, comp, 39K ±5%, 1/4w	188466	1		
R9	Res, comp, 15Ω ±5%, 1/4w	147876	1		
R10,R11,R17	Res, comp, 1K	148023	3		
R12,R14,R19 thru R22	Res, comp, 3K ±5%, 1/4w	193508	6		
R13	Res, met flm, 13.7K ±1%, 1/8w	236752	1		
R15,R23,R26	Res, comp, 510Ω ±5%, 1/4w	218032	1		
R16,R18,R25	Res, comp, 390Ω ±5%, 1/4w	147975	3		
R24	Res, comp, 2.7Ω ±5%, 1/4w	246744	1		
R27	Res, comp, 270Ω ±5%, 1/4w	160804	1		

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
U1	I.C., TTL, Hex inverter, Buffer/Driver	288605	1		
U2	I.C., DTL, Quad 2–Input NAND Gate	268375	1		
U3	I.C., DTL, Binary Counter	267153	1		



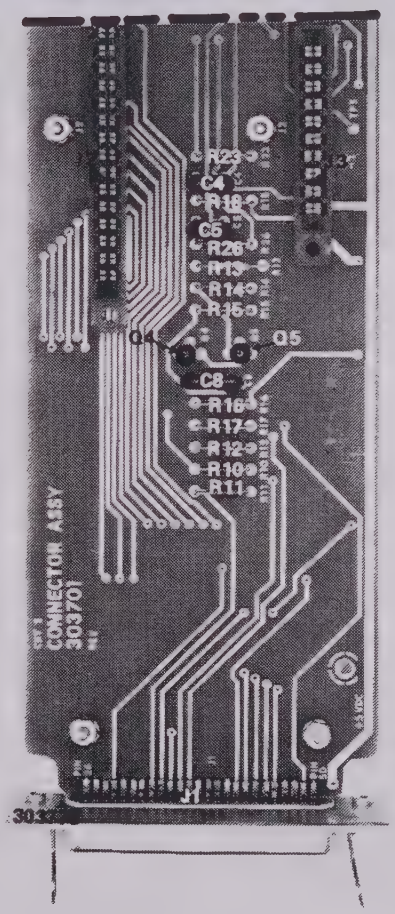


Figure 6-9. CONNECTOR ASSEMBLY PCB (A4200-4001)

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A2	**PROGRAM ASSEMBLY** **Figure 6—10.**	REF			
S1 thru S8	Switch Assembly (8 pushbutton)	306589	1		
S9 thru S17	Switch Assembly (9 pushbutton)	306571	1		

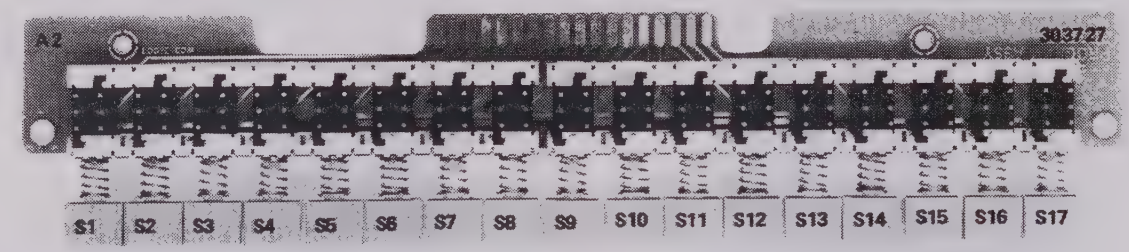


Figure 6-10. PROGRAM ASSEMBLY

REF DESIG	DESCRIPTION	STOCK NO	TOT QTY	REC QTY	USE CODE
A3	**FUNCTION ASSEMBLY PCB** **Figure 6—11.**	REF			
R1	Res, comp, 51Ω ±5%, 1/4w	221879	1		
S1 thru S8	Switch Assembly (8 pushbutton)	306589	1		
S9 thru S12	Switch Assembly (4 pushbutton)	306597	1		
	Connector pin	267500	6		

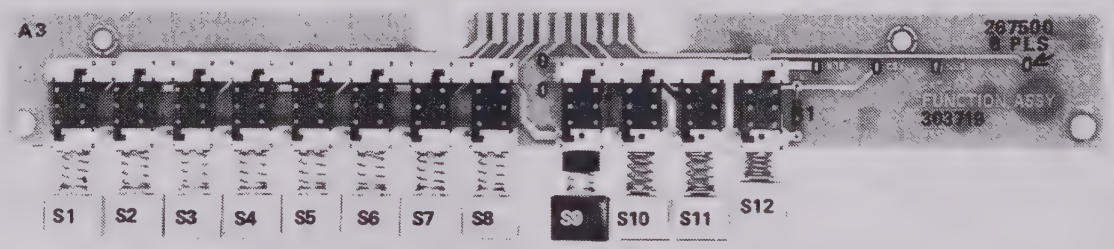
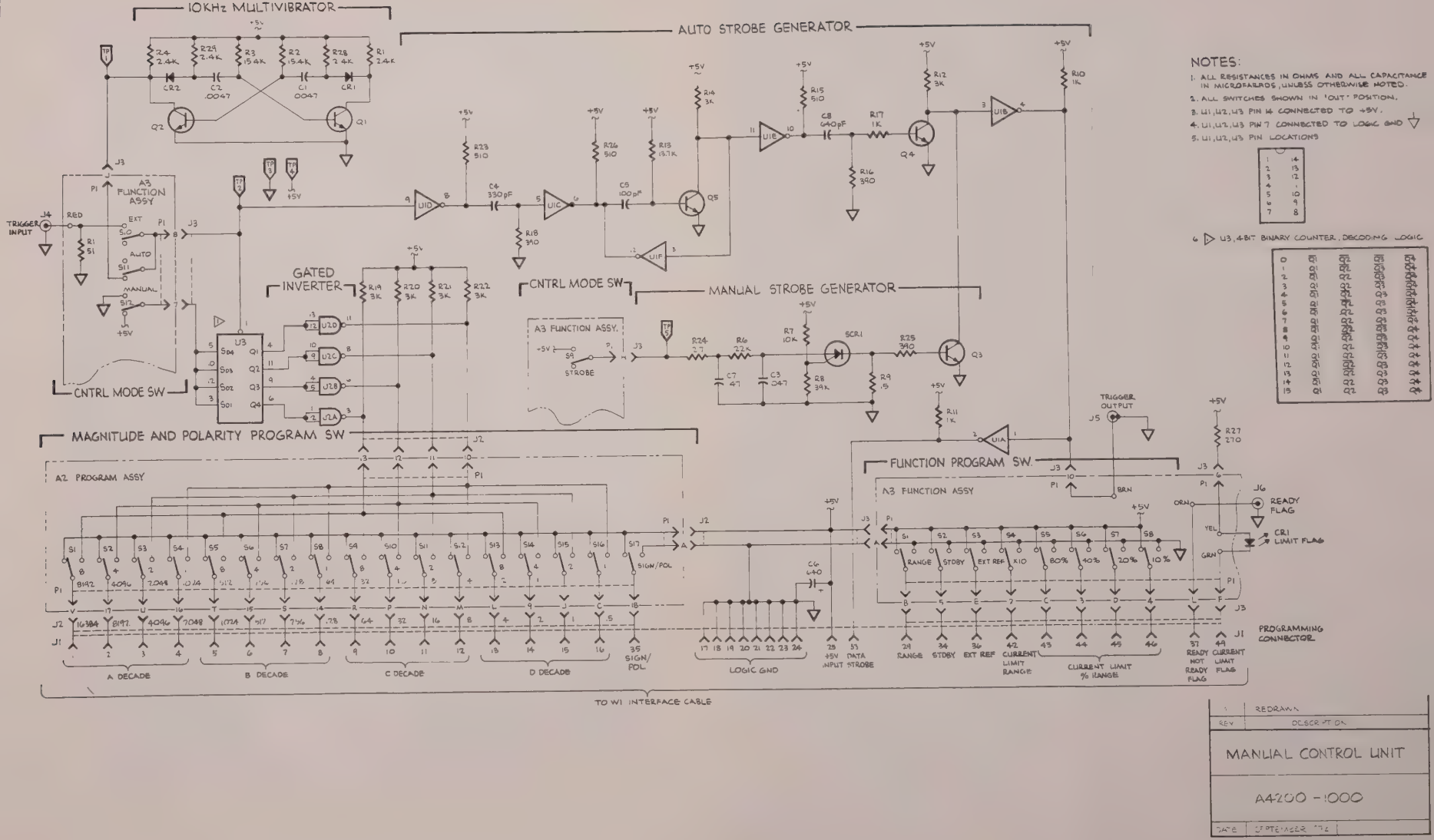


Figure 6-11. FUNCTION ASSEMBLY

MANUFACTURERS' CROSS REFERENCE LIST

FLUKE STOCK NO.	MFR.	MFR. PART NO.
130138	70485	366
147876	01121	CB1505
147975	01121	CB3915
148023	01121	CB1025
148106	01121	CB1035
148130	01121	CB2235
148445	14655	CD15F330J
148494	14655	CD15F101J
152033	02660	UG1094A/U
159855	07910	CS23030
160804	01121	CB2715
178608	73445	C437ARC640
182972	02799	PE–472–G
184366	73445	C280AE/A470K
188466	01121	CB3935
193433	01121	CB2425
193508	01121	CB3025
203323	03508	DHD1105
207555	14655	DMF2S47
215251	14655	CD19F641J
218032	01121	CB5115
221879	01121	CB5105
236752	91637	Type MFF 1/8
246744	01121	CB27G5
261651	91637	Type MFF 1/8
267153	04713	MC839P–6921
267252	02660	57–40500
267500	00779	86144–2
268110	03508	D13T1
268375	04713	MC846P
285247	02660	225-21821-110
288605	01295	SN7416N
292912	02660	225–21021–110
303354	89536	303354
303701	89536	303701
303743	89536	303743
303750	89536	303750
303719	89536	303719
303727	89536	303727
303768	89536	303768
306571	89536	306571
306597	89536	306597
306589	89536	306589
309617	71318	FLV102
309625	07263	FVC 001T



NOTES:

1. ALL RESISTANCES IN OHMS AND ALL CAPACITANCE IN MICROFARADS, UNLESS OTHERWISE NOTED.
2. ALL SWITCHES SHOWN IN 'OUT' POSITION.
3. U1, U2, U3 PIN 14 CONNECTED TO +5V.
4. U1, U2, U3 PIN 7 CONNECTED TO LOGIC GND ⏚
5. U1, U2, U3 PIN LOCATIONS

1	14
2	13
3	12
4	11
5	10
6	9
7	8

6 ▷ U3, 4-BIT BINARY COUNTER, DECODING LOGIC

0				
1	Q1			
2		Q2		
3	Q1	Q2		
4			Q3	
5	Q1		Q3	
6		Q2	Q3	
7	Q1	Q2	Q3	
8				Q4
9	Q1			Q4
10		Q2		Q4
11	Q1	Q2		Q4
12			Q3	Q4
13	Q1		Q3	Q4
14		Q2	Q3	Q4
15	Q1	Q2	Q3	Q4

REV	DESCRIPTION
1	REDRAWN

MANUAL CONTROL UNIT

A4200 - 1000

DATE 27 OCTOBER 1972

Accessory
Rack Mounting Fixtures

6-1. INTRODUCTION

6-2. The Accessory Rack Mounting Kits are of two general types: half-rack width and full-rack width. The half-rack width mountings are further divided into dual mountings, center mountings, and offset mountings. Chassis Slide Kits, which enable withdrawl of the rack mounted instrument for inspection and servicing, can be installed on full-width rack instruments and on half-rack width instruments when in the dual mounting configuration. Figure 6-1 shows the variations possible in rack mountings and the configurations which can use chassis slides, all variations related to the standard 19-inch equipment rack.

6-3. INSTALLATION PROCEDURES

6-4. Half-Rack Width Mountings

6-5. The half-rack width mountings are shown in Figure 6-1 as A, B, and C. The full-rack mounting is shown as D. To install the mountings shown in Figure 6-1 B through D, proceed as follows:

a. Disconnect the line power cord.

b. Peel the decal shown in Figure 6-2 from each front side panel.

c. Install the mounting brackets on each front side panel using the #8-32 x 1/2" PHP screws provided in the kit. The mounting brackets for offset installation can be installed on either side, as desired.

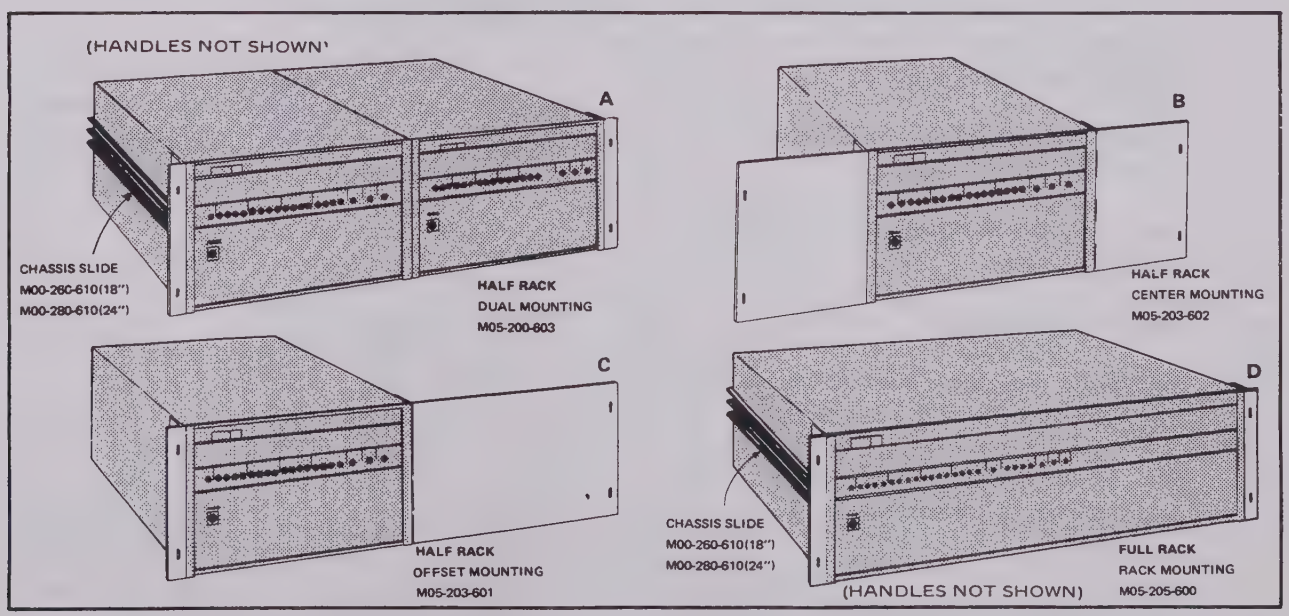


Figure 6-1. ACCESSORY RACK MOUNTING KITS

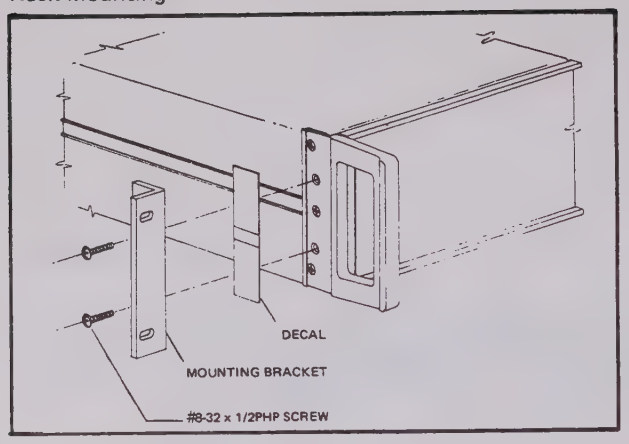


Figure 6-2. RACK MOUNTING BRACKET INSTALLATION

d. Remove the feet from the bottom dust cover.

e. Slide the instrument into the equipment rack and secure it in place with fasteners through the mounting brackets.

NOTE!

Chassis slides should be installed on the full-rack width units. See Figure 6-1, A.

f. Connect the power cord to line power.

6-6. Half-Rack Dual Units Installation

6-7. Two half-rack width instruments can be installed side-by-side in an equipment rack using the M05-200-603 Rack Mounting Kit. To install these components and mount the units in the equipment rack, proceed as follows:

a. Ensure that the power cord of each instrument is disconnected from line power.

b. Peel the front and rear side panel decals from each instrument.

c. Select one instrument and remove the top and bottom dust covers.

d. Remove the guard cover.

e. Remove the three screws from the front side panel that will mate to the other instrument.

f. Pull the front panel forward slightly and then thread the #8-32 fasteners into the P-nuts shown in Figure 6-3.

g. Push the front panel into position, making sure that each PCB is correctly mated into the mother board PCB, and then install the three screws in the front side panel.

h. Thread the #8-32 fasteners into the P-nuts located on the inner rear side panel that will mate to the other instrument.

i. Bolt the two instruments together as shown in Figure 6-3.

j. Install the guard cover removed in step d.

k. Remove the feet from the bottom dust cover of each instrument.

l. Install the top and bottom dust covers removed in step b.

m. Install the mounting brackets shown in Figure 6-2 on the outer front side panels. Use the #8-32 x 1/2" PHP screws provided in the kit.

n. Slide the two instruments into the equipment rack and secure them in place with fasteners through the mounting brackets.

NOTE!

Refer to paragraph 6-8 for chassis slide installation.

o. Connect the power cords to line power.

6-8. Chassis Slide Installation

6-9. The M00-260-610 (18") or M00-280-610 (24") Chassis Slide Kit should be installed to better facilitate dual rack mounting or installation of full-width rack units. To

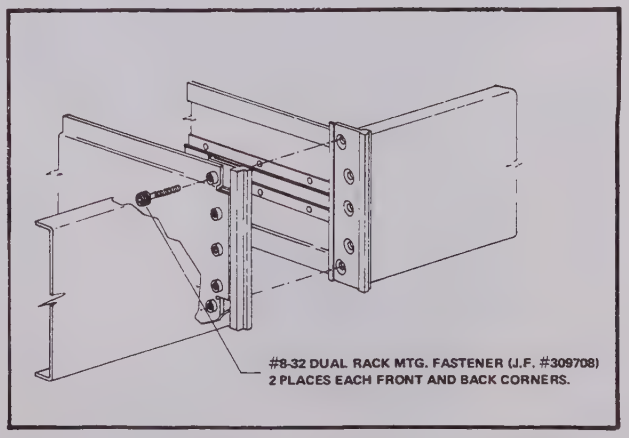


Figure 6-3. DUAL RACK MOUNTING

install these components and mount the units or unit in the equipment rack, proceed as follows:

a. Peel the center side panel decals from the instrument.

b. Peel the rear side panel decals from the instrument.

c. Remove the six screws from the rear panel corner brackets and then remove the brackets.

d. Slide the spacer (A) into the center section of the side panel until the tapped holes are aligned with the holes in the side panels.

e. Scribe a line on spacer where it protrudes from the rear of the side panel and then remove it from the instrument.

f. Cut off the spacer at the scribe mark and then install it in the side panel.

g. Install the rear panel corners.

h. Attach the chassis section (B) to the side panels with the screws (C) provided in the kit.

i. Install the cabinet sections (E) and center sections (D) in equipment rack. The extension angle brackets, which are part of section (E), are mounted at the rear of the cabinet.

j. Slide the center sections (D) toward the front of the cabinet until they lock in place.

k. Depress the spring locks on the chassis sections (B) and insert the instrument between the extended center sections (D) on the cabinet.

l. Slide the instrument completely into the equipment rack and secure in place with fasteners through the mounting brackets.

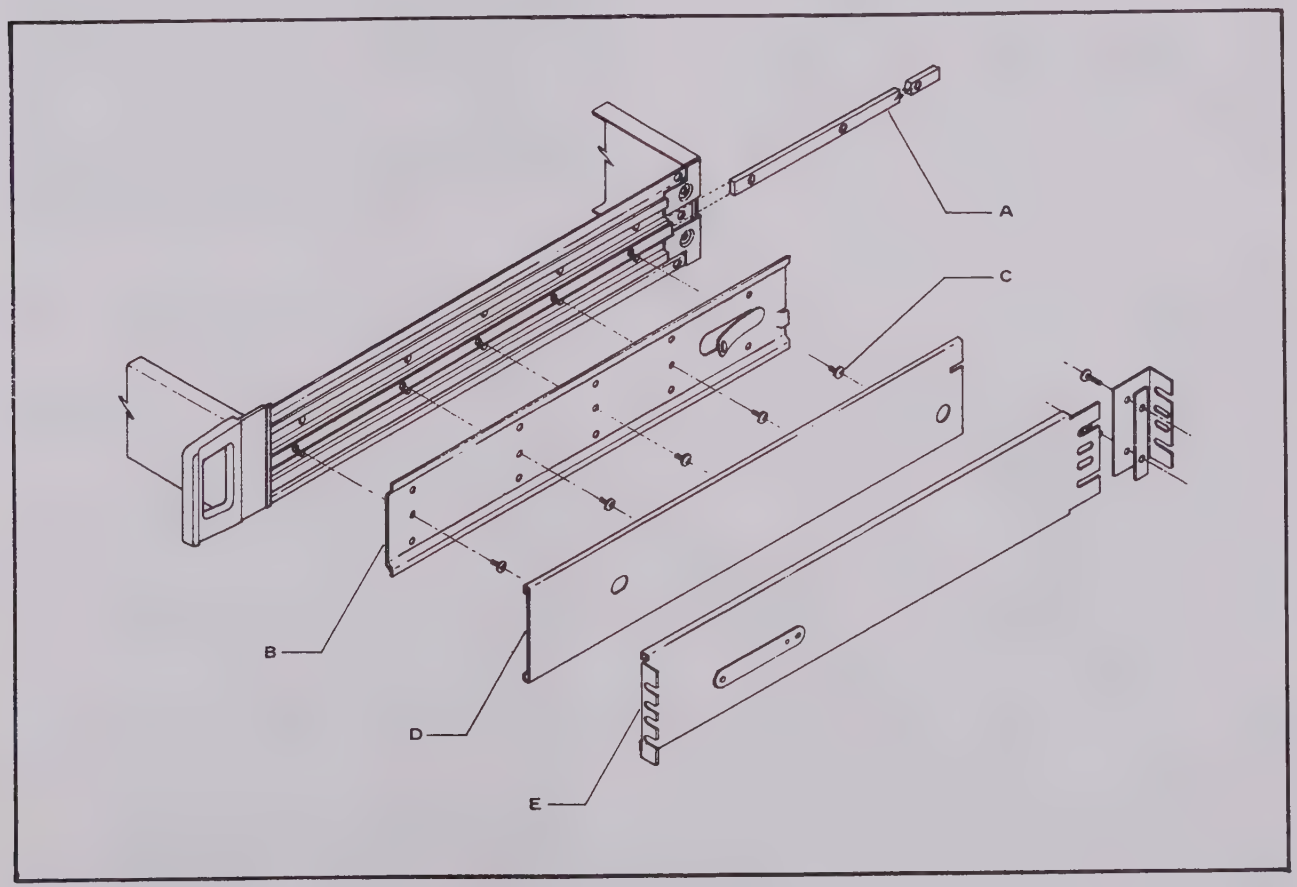


Figure 6-4. CHASSIS SLIDE INSTALLATION

Accessory

Programming Connector

6-1. INTRODUCTION

6-2. The Amphenol, male, programming connector shown in Figure 6-1 is used to interface the instrument to a programming source. This male programming connector mates with the female programming connector that is mounted on the rear panel of the instrument. A male connector is normally supplied with each instrument, less cabling, but may also be ordered directly from Amphenol under PART NO. 57-30500, or from the John Fluke Mfg. Co., Inc., by referencing FLUKE PART NO. 266056.

6-3. ASSEMBLY INSTRUCTIONS

6-4. Cabling connections to the male programming connector are done as follows:

a. Remove the screws from the terminal cover of the male connector and remove the cover and numbered terminal/pin insert.

b. Remove the screws from the restraining clamps on the cover and spread the clamps.

c. Thread the cable wiring through the terminal cover. Maximum size is #22.

d. Solder the wiring to the appropriate terminals of the numbered insert. Refer to Figure 6-1 for terminal locations. Use pin cover to support insert during soldering.

e. Slide the covers together and install the attaching screws.

f. Close the restraining clamp around the cable and install the screws. If necessary, wrap the wiring bundle to provide a proper diameter for the restraining clamp.

g. Connect the male programming connector to the female connector on the rear panel of the instrument. Fasten them securely with the end clips.

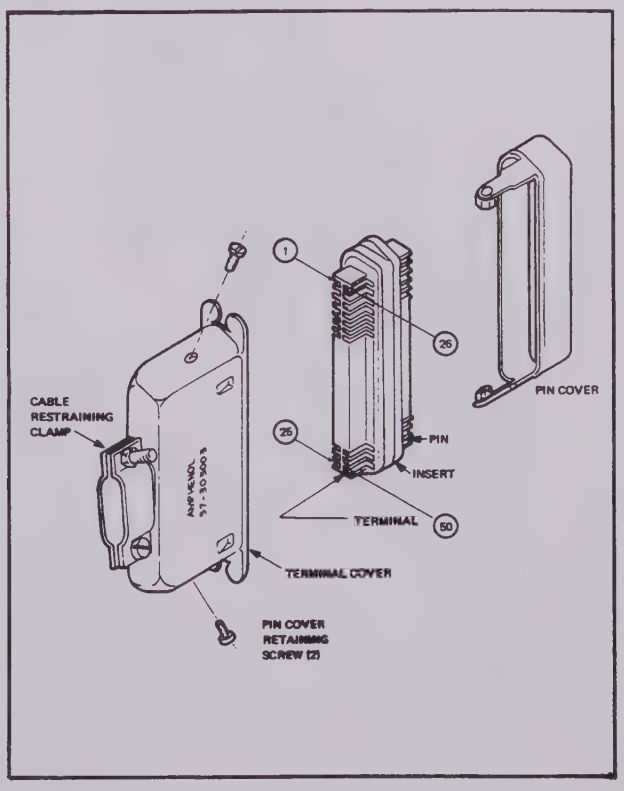


Figure 6-1. MALE PROGRAMMING CONNECTOR

Accessories

Extender PCB Assembly and Cable Extender Assembly

6-1. INTRODUCTION

6-2. The Extender PCB Assembly shown in Figure 6-1 is available as an accessory for the FLUKE series of 4200 power sources. This accessory permits the printed circuit boards in the power source to be extended for servicing. The Extender PCB Assembly can be obtained by ordering FLUKE PART NO. 292623.

6-3. INSTALLATION

6-4. Extender PCB Assembly

6-5. To install a printed circuit board on the extender as shown in Figure 6-2, proceed as follows:

a. Turn off the power source, remove the line power cord, and then remove the top dust cover and guard cover.

b. Locate the printed circuit board to be serviced and remove it using the information given in Section 4, MAINTENANCE ACCESS.

c. Install the extender into the mother board connector as shown in Figure 6-2.

d. Support the extender and install the printed circuit board into the extender connector as shown in Figure 6-2.

CAUTION!

THE COMPONENT SIDE OF THE PRINTED CIRCUIT BOARD THAT IS INSERTED INTO THE EXTENDER CONNECTOR MUST FACE THE FRONT OF THE INSTRUMENT.

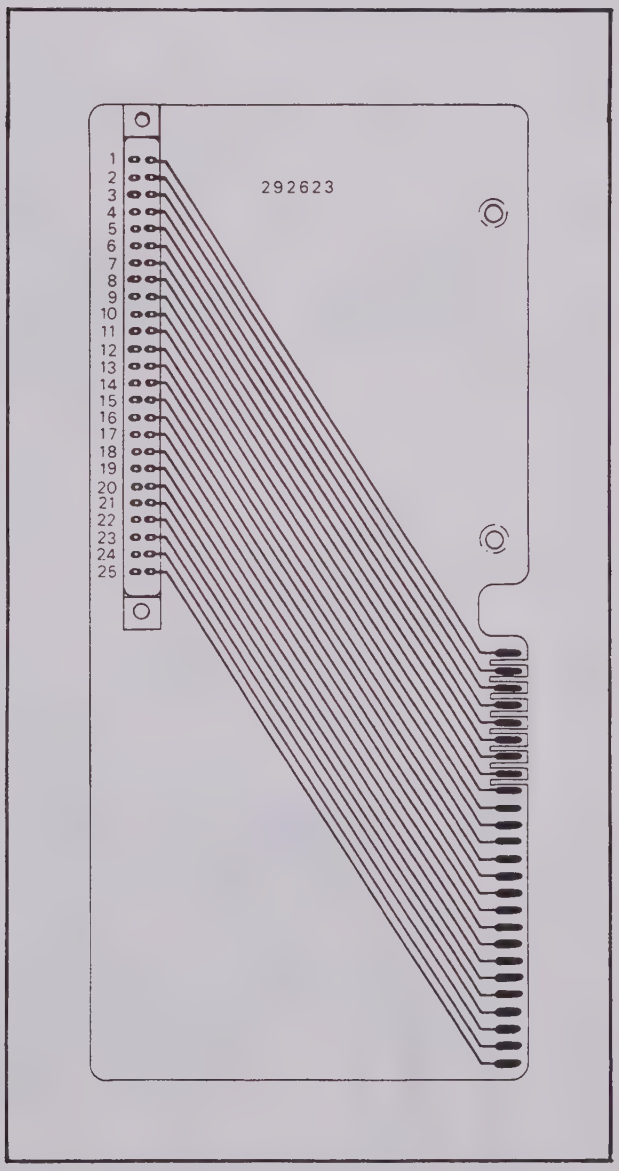


Figure 6-1. PCB ASSEMBLY EXTENDER

6-6. Cable Extender Assembly

a. The removal of certain interconnected printed circuit boards requires the use of a cable extender assembly to reconnect the board to its original electrical configuration after the board is inserted into the extender PCB. The cable extender assembly is shown in Figure 6-3, and is obtained by ordering FLUKE PART NO. 337584.

b. Usage of the cable extender assembly is shown in Figures 6-4 and 6-5 for the instruments requiring its use. Normally the cable extender assembly is not used with the 4210A/4216A instruments unless troubleshooting of the power supply PCB would require separating and remotely locating the ac input power controls and input transformer. The cable extender assembly would join the ac input power controls and input transformer to the power supply PCB.

c. After the extender PCB assembly and test PCB and, where required, the cable extender assembly are connected, the power can be applied.

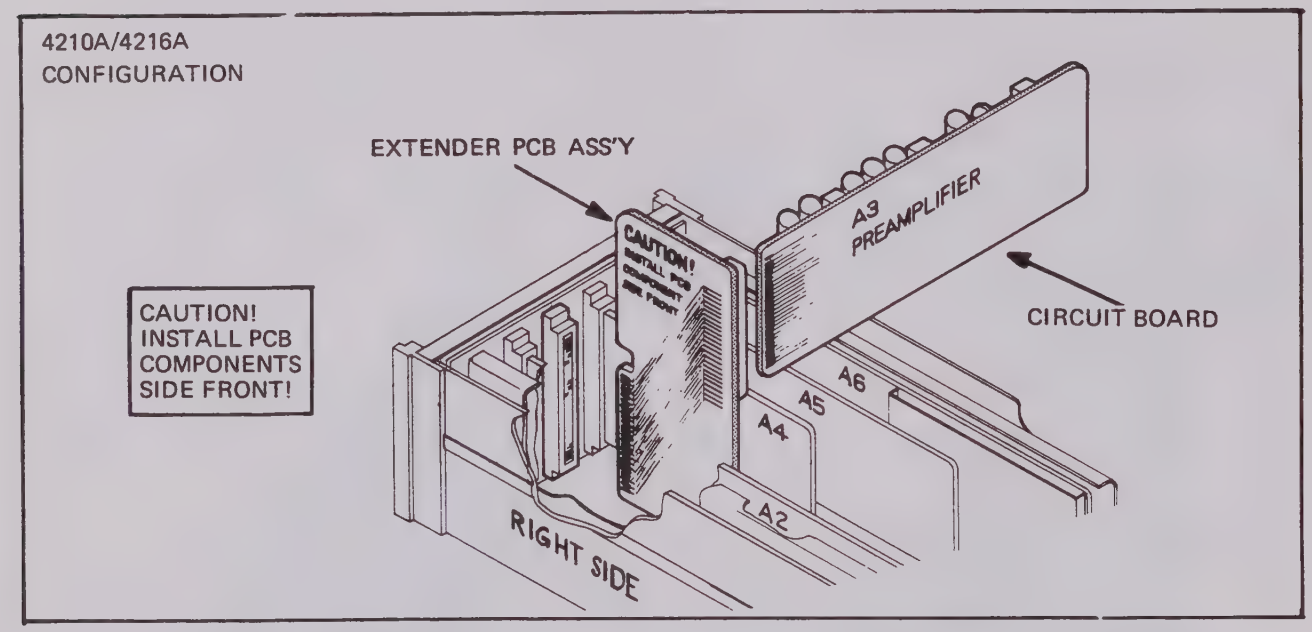


Figure 6-2. EXTENDER PCB ASSEMBLY INSTALLED IN 4210A/4216A INSTRUMENT

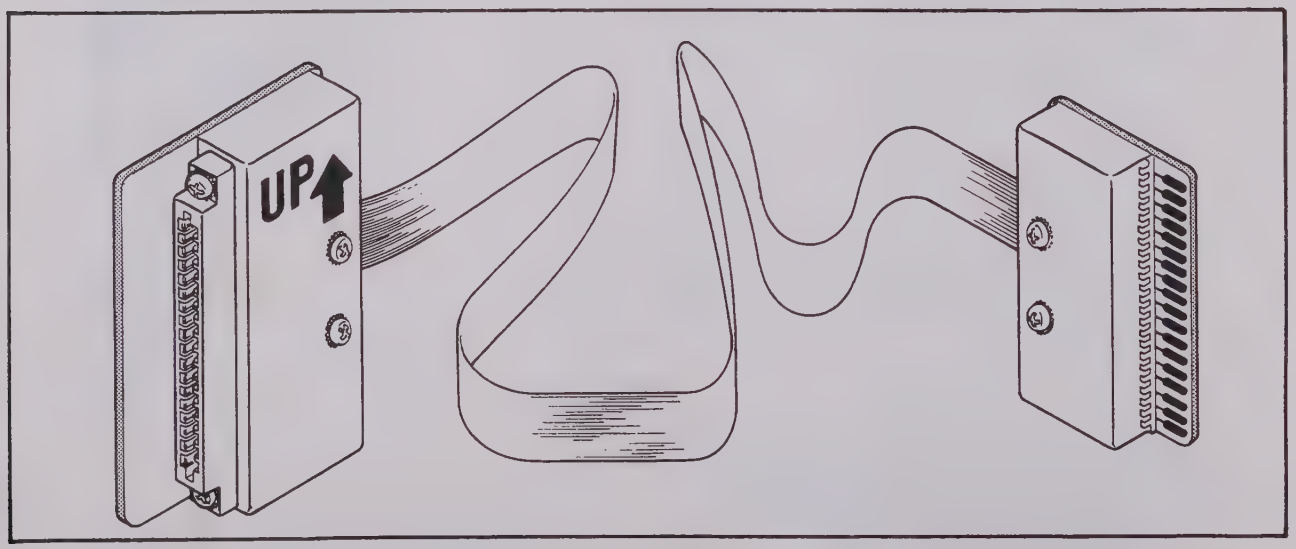


Figure 6-3. CABLE EXTENDER ASSEMBLY

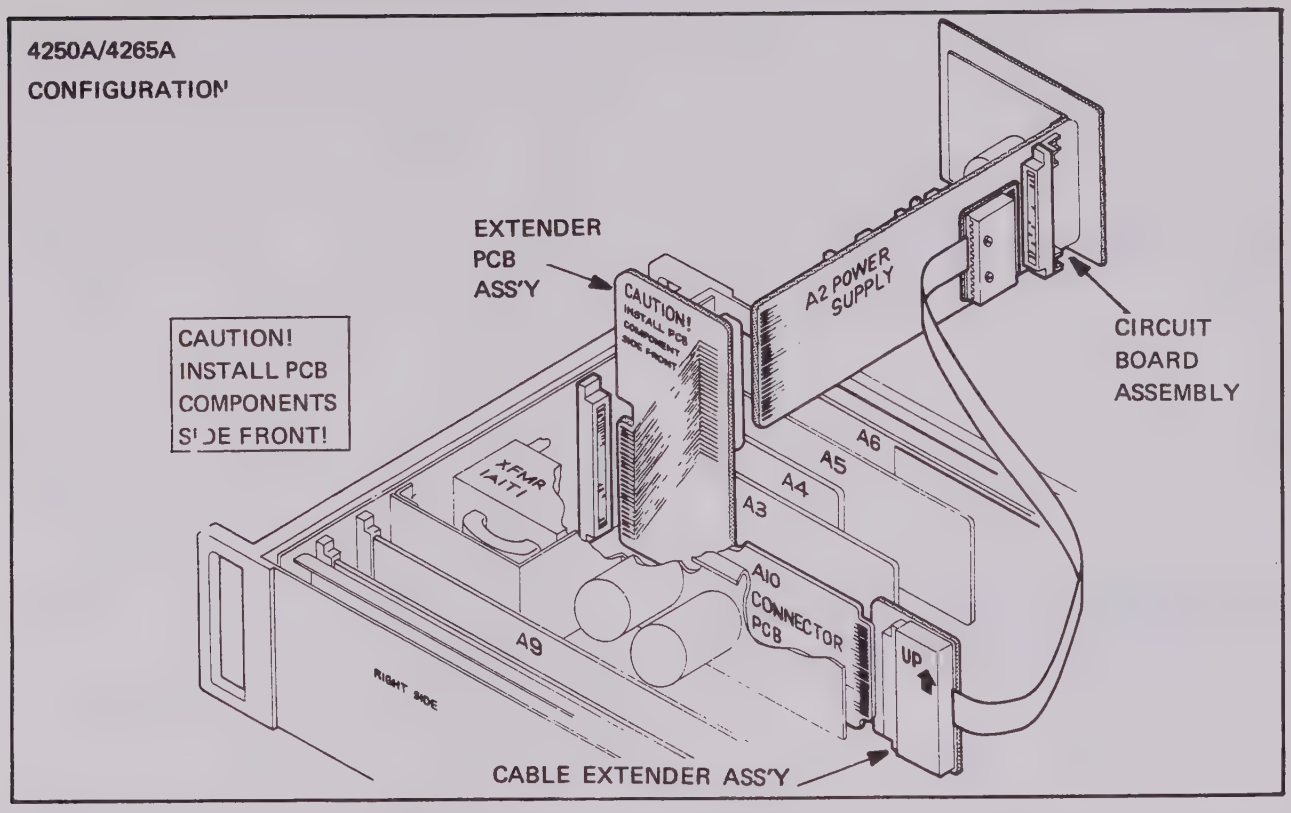


Figure 6-4. EXTENDER PCB AND CABLE EXTENDER ASSEMBLIES INSTALLED IN 4250A/4265A INSTRUMENTS

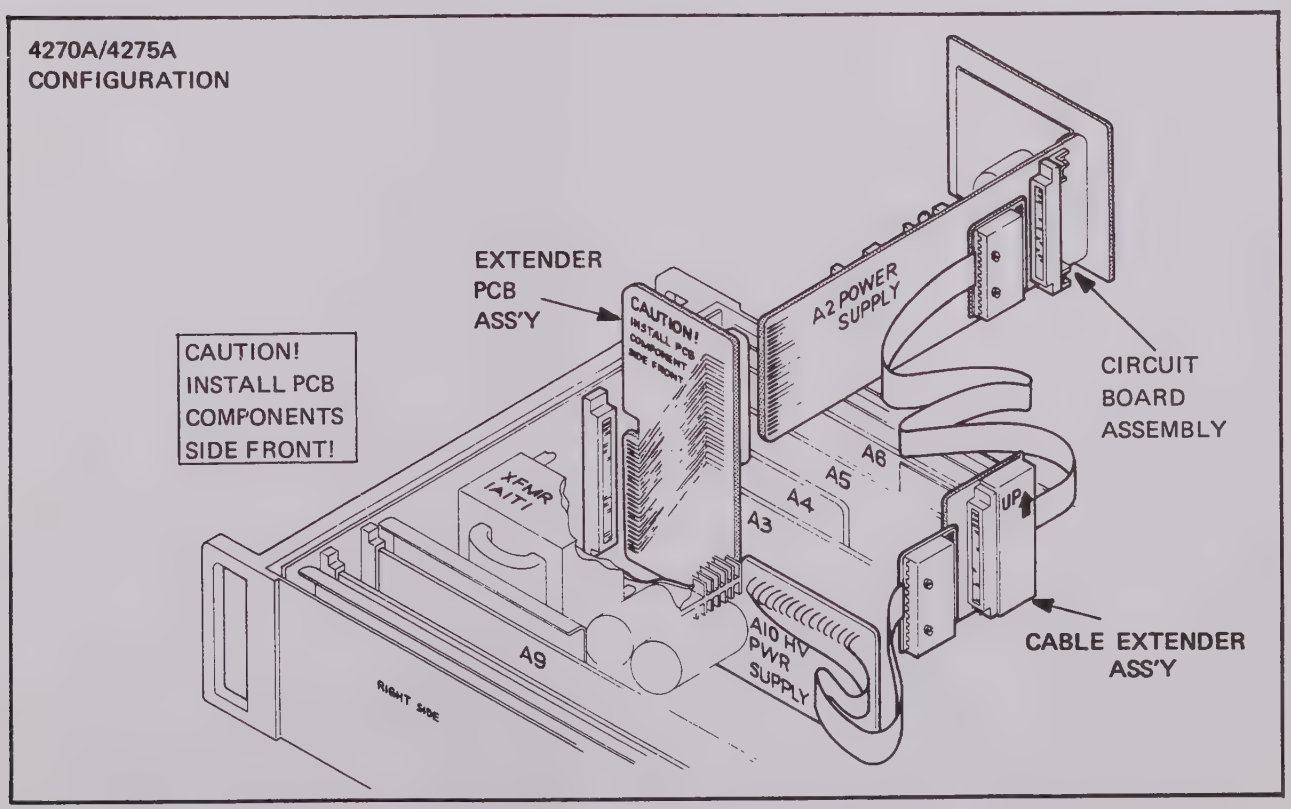


Figure 6-5. EXTENDER PCB AND CABLE EXTENDER ASSEMBLIES INSTALLED IN 4270A/4275A INSTRUMENTS

Section 7

General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the List of Replaceable Parts contained in Section 5.

D9816
Westermann Wilhelm Augusta-Anlage
Mannheim-Nackarau Germany

S0482
Sony Corp.
Tokyo, Japan

S3774
Oshino Electric Lamp Works
Tokoyo, Japan

0AD86
IN General
El Paso, TX

0AE89
Autosplice Inc.
Woodside, NY

0BW21
Noritake Co. Inc.
Burlington, MA

0ANF0
Topaz Semiconductor Inc
San Jose, CA

0DSM7
Conductive (Pkg) Containers Inc.
Brookfield, WI

0CLN7
Emhart Fastening Group
Shelton, CT

0FB81
S-Mos Systems Inc.
San Jose, CA

0FFP1
Everready LTD
Ever Ready Special Battery Div.
Dawley Telford Salop UK

00199
Marcon Electronics Corp
Kearny, NJ

00213
Nytronics Comp. Group Inc.
Darrlingon, NC

00327
Welwyn International Inc.
Westlake, OH

00656
Aerovox Corp.
New Bedford, MA

00686
Film Capacitors Inc.
Passaic, NJ

00779
AMP, Inc.
Harrisburg, Pennsylvania

00853
Sangamo Weston Inc
Components Div
Pickens, NC

01091
Allied Plastics Co.
Los Angeles, CA

01101
Wabash Inc
(Formerly Wabash Magnetics)
Wabash, IN

01121
Allen Bradley Co.
Milwaukee, WI

01281
TRW Electronics & Defense Sector
R F Devices
Lawndale, CA

01295
TX Instruments Inc.
Semiconductor Group
Dallas, TX

01526
Genicom
Waynesboro, VA

01537
Motorola Communications &
Electronics Inc.
Franklin Park, IL

01686
RCL Electronics/Shallcross Inc.
Electro Components Div.
Manchester, NH

01884
Sprague Electric Co.
(Now 56289)

01961
Varian Associates Inc.
Pulse Engineering Div.
Convoy, CT

01963
Cherry Electrical Products Corp
Waukegan, IL

02111
Spectrol Electronics Corp.
City of Industry, CA

02114
Amperex Electronic Corp.
Ferrox Cube Div.
Saugerties, NY

02131
General Instrument Corp.
Government Systems Div.
Westwood, MA

02395
Sonar Radio Corp.
Hollywood, FL

02533
Leigh Instruments Ltd.
Frequency Control Div.
Don Mills, Ontario, Canada

02606
Fenwal Labs
Division of Travenal Labs
Morton Grove, IL

02660
Bunker Ramo-Eltra Corp.
Amphenol NA Div.
Broadview, IL

02697
Parker-Hannifin Corp.
O-Ring Div
Lexington, KY

02735
RCA-Solid State Div.
Somerville, NJ

02768
ITW (IL Tool Works)
Fastex Division
Des Plaines, IL

02799
Arco Electronics Inc.
Chatsworth, CA

03296
Nylon Molding Corp.
Monrovia, CA

03445
Lercon Electronics Inc
Burbank, CA

03508
General Electric Co.
Semiconductor Products
& Batteries
Auburn, NY

03797
Genisco Technology Corp.
Eltronics Div.
Rancho Dominquez, CA

03877
Gilbert Engineering Co.Inc
Incon Sub of Transitron
Electronic Corp.
Glendale, AZ

03888
KDI Electronics Inc.
Pyrofilm Div.
Whippany, NJ

03911
Clairex Corp.
Clairex Electronics Div.
Mount Vernon, NY

03980
Muirhead Inc.
Mountainside, NJ

04009
Cooper Industries, Inc.
Arrow Hart Div.
Hartford, CT

04217
Essex International Inc.
Wire & Cable Div.
Anaheim, CA

04221
Midland-Ross Corp.
Midtex Div.
N. Mankato, MN

04222
AVX Corp.
AVX Ceramics Div.
Myrtle Beach, SC

04423
Telonic Berkley Inc.
Laguna Beach, CA

04713
Motorola Inc.
Semiconductor Group
Phoenix, AZ

04946
Standard Wire and Cable
Rancho Dominquez, CA

05173
General Radio
NY,NY.
Replaced by:

24655
Genrad,INC.
Concord, MA

05236
Jonathan Mfg. Co.
Fullerton, CA

05245
Corcom Inc.
Libertyville, IL

05276
ITT Pomona
Electronics Div.
Pomona, CA

05277
Westinghouse Elec. Corp.
Semiconductor Div.
Youngwood, PA

05347
Ultronix Inc
Grand Junction, CO

05397
Union Carbide Corp.
Materials Systems Div.
Cleveland. OH

05571
Sprague Electric Co.
(Now 56289)

05574
Viking Connectors Inc
Sub of Criton Corp.
Chatsworth, CA

05791
LYN-TRON
Burbank, CA

05820
EG & G Wakefield Engineering
Wakefield, MA

05839
Advance Electrical
Chicago, IL

05972
Loctite Corp.
Newington, CT

06001
General Electric Co.
Electric Capacitor Product Section
Columbia, SC

06141
Fairchild Weston Systems Inc.
Data Systems Div.
Sarasota, FL

06192
La Deau Mfg. Co.
Glendale, CA

06229
Electrovert Inc.
Elmsford, NY

06383
Panduit Corp.
Tinley Park, IL

06473
Bunker Ramo Corp.
Amphenol NA Div.
SAMS Operation
Chatsworth, CA

06540
Mite Corp
Amatom-Electrical Div

06555
Beede Electrical Instrument
Penacook, NH

06665
Precision Monolithics
Sub of Boums Inc.
Santa Clara, CA

06666
General Devices Co. Inc.
INpolis, IN

06739
Electron Corp.
Littleton, CO

06743
Gould Inc.
Foil Div.
Eastlake, OH

06751
Components Inc.
Semcor Div.
Phoenix, AZ

06776
Robinson Nugent Inc.
New Albany, IN

06915
Richco Plastic Co.
Chicago, IL

06961
Vernitron Corp.
Piezo Electric Div.
Bedford, OH

06980
EIMAC
(See Varian)
San Carlos, CA

07047
Ross Milton Co., The
Southampton, PA

07138
Westinghouse Electric Corp.
Industrial & Government
Tube Div.
Horseheads, NY

07233
Benchmark Technology Inc.
City of Industry, CA

07239
Biddle Instruments
Blue Bell, PA

07256
Silicon Transistor Corp.
Sub of BBF Inc.
Chelmsford, MA

07261
Avnet Corp.
Culver City, CA

07263
Fairchild Semiconductor
North American Sales
Ridgeview, CT

07344
Bircher Co. Inc., The
Rochester, NY

07374
Optron Corp
Woodbridge, CT

07557
Campion Co. Inc.
Philadelphia, PA

07597
Bumdy Corp.
Tape/Cable Div.
Rochester, NY

07716
TRW Inc. (Can use 11502)
IRC Fixed Resistors/
Burlington
Burlington, VT

07792
Lerma Engineering Corp.
Northampton, MA

07810
Bock Corp.
Madison, WI

07910
Teledyne Semiconductor
Mtn. View, CA

07933
Raytheon Co.
Semiconductor Div.
Mountain View, CA

08FG6
Calmos Systems Inc.
Kanata, Ont. Canada

080A9
Dallas Semiconductor
Dallas, TX

08111
MF Electronics
New Rochelle, NY

08235
Industro Transistor Corp.
Long Island City, NY

08261
Spectra-Strip
An Eltra Co.
Garden Grove, CA

08445
Electri-Cord Mfg., Inc
Westfield, PA

08530
Reliance Mica Corp.
Brooklyn, NY

08718
ITT Cannon Electric
Phoenix Div.
Phoenix, AZ

08806
General Electric Co.
Minature Lamp Products
Cleveland, OH

08863
Nylomatic
Fallsington, PA

08988
Skottie Electronics Inc.
Archbald, PA

09021
Airco Inc.
Airco Electronics
Bradford, PA

09023
Cornell-Dublier Electronics
Fuquay-Varina, NC

09214
General Electric Co.
Semiconductor Products Dept.
Auburn, NY

09353
C and K Components Inc.
Newton, MA

09423
Scientific Components Inc.
Santa Barbara, CA

09922
Burndy Corp.
Norwalk, CT

09969
Dale Electronics Inc.
Yankton, SD

09975
Burroughs Corp.
Electronics Components
Detroit, MI

1A791
LFE Electronics
Danvers, MA

1B715
(United Shoe & Nylock Corp)
-Nylock Fastener Corp.-
Paramus, NJ

10059
Barker Engineering Corp.
Kenilworth, NJ

10389
IL Tool Works Inc.
Licon Div.
Chicago, IL

11236
CTS Corp.
Resistor Products Div.
Berne, IN

11237
CTS Corp of CA
Electro Mechanical Div.
Paso Robles, CA

11295
ECM Motor Co.
Schaumburg, IL

11358
Columbia Broadcasting System
CBS Electronic Div.
Newburyport, MA

11403
Vacuum Can Co.
Best Coffee Maker Div.
Chicago, IL

11502 (can also use 35009)
TRW Inc.
TRW Resistive Products Div.
Boone, NC

11503
Keystone Columbia Inc.
Freemont, IN

11532
Teledyne Relays Teledyne
Industries Inc.
Hawthorne, CA

11711
General Instrument Corp.
Rectifier Div.
Hicksville, NY

11726
Qualidyne Corp.
Santa Clara, CA

12014
Chicago Rivet & Machine Co.
Naperville, IL

12020
Ovenaire
Div. of Electronic Technologies
Charlottesville, VA

12038
Simco
(Div of Ransburg Corp)
Hatfield, PA

12040
National Semiconductor Corp.
Danbury, CT

12060
Diodes Inc.
Northridge, CA

12136
PHC Industries Inc.
Formerly Philadelphia Handle Co.
Camden, NJ

12300
AMF Canada Ltd.
Potter-Brumfield
Guelph, Ontario, Canada

12323
Practical Automation Inc.
Shelton, CT

12327
Freeway Corp.
Cleveland, OH

12406
Elpac Electronics Inc.
Santa Ana, CA

12443
Budd Co.,The
Plastics Products Div.
Phoenixville, PA

12581
Hitachi Metals International Ltd.
Hitachi Magna-Lock Div.
Big Rapids, MO

12615
US Terminals Inc.
Cincinnati, OH

12617
Hamlin Inc.
LaKe Mills, WI

12673
Wesco Electrical
Greenfield, MA

12697
Clarostat Mfg. Co. Inc.
Dover, NH

12749
James Electronic Inc.
Chicago, IL

12856
MicroMetals Inc.
Anaheim, CA

12881
Metex Corp.
Edison, NJ

12895
Cleveland Electric Motor Co.
Cleveland, OH

12954
Microsemi Corp.
Components Group
Scottsdale, AZ

12969
Unitrode Corp.
Lexington, MA

13050
Potter Co.
Wesson, MS

13103
Thermalloy Co., Inc.
Dallas, TX

13327
Solitron Devices Inc.
Tappan, NY

13511
Bunker-Ramo Corp.
Amphenol Cadre Div.
Los Gatos, CA

13606
Sprague Electric Co.
(Use 56289)

13689
SPS Technologies Inc.
Hatfield, NJ

13764
Micro Plastics
Flippin, AZ

13919
Burr-Brown Research Corp.
Tucson, AZ

14099
Semtech Corp.
Newbury Park, CA

14140
McGray-Edison Co.
Commercial Development Div.
Manchester, NH

14189
Ortronics, Inc.
Orlando, FL

14193
Cal-R-Inc.
Santa Monica, CA

14301
Anderson Electronics
Hollidaysburg, PA

14329
Wells Electronics Inc.
South Bend, IN

14482
Watkins-Johnson Co.
Palo Alto, CA

14552
Microsemi Corp.
(Formerly Micro-Semiconductor)
Santa Ana, CA

14604
Elmwood Sensors, Inc
Pawtucket, RI

14655
Cornell-Dublier Electronics
Div. of Federal Pacific
Electric Co. Govt Cont Dept.
Newark, NJ

14704
Crydom Controls
(Division of Int Rectifier)
El Segundo, CA

14752
Electro Cube Inc.
San Gabriel, CA

14936
General Instrument Corp.
Discrete Semi Conductor Div.
Hicksville, NY

14949
Trompeter Electronics
Chatsworth, CA

15412
Amtron
Midlothian, IL

15542
Scientific Components Corp.
Mini-Circuits Laboratory Div.
Brooklyn, NY

15636
Elec-Trol Inc.
Saugus, CA

15782
Bausch & Lomb Inc.
Graphics & Control Div.
Austin, TX

15801
Fenwal Eletronics Inc.
Div. of Kidde Inc.
Framingham, MA

15818
Teledyne Inc. Co.
Teledyne Semiconductor Div.
Mountain View, CA

15849
Useco Inc.
(Now 88245)

15898
International Business
Machines Corp.
Essex Junction, VT

16068
International Diode Div.
Harrison, NJ

16162
MMI
Southfield, MI

16245
Conap Inc.
Olean, NY

16258
Space-Lok Inc.
Burbank, CA

16352
Codi Corp.
Linden, NJ

16469
MCL Inc.
LaGrange, IL

16473
Cambridge Scientific Industries
Div. of Chemed Corp.
Cambridge, MD

16733
Cablewave Systems Inc.
North Haven, CT

16742
Paramount Plastics
Fabricators Inc.
Downey, CA

16758
General Motors Corp.
Delco Electronics Div.
Kokomo, IN

17069
Circuit Structures Lab
Burbank, CA

17117
Electronic Molding Corp.
Woonsocket, RI

17338
High Pressure Eng. Co. Inc.
OK City, OK

17504
Aluminum Filter Co.
Carpinteria, CA

17545
Atlantic Semiconductors Inc.
Asbury Park, NJ

17745
Angstrohm Precision, Inc.
Hagerstown, MD

17856
Siliconix Inc.
Santa Clara, CA

18178
E G & Gvactee Inc.
St. Louis, MO

18235
KRL/Bantry Components Inc.
Manchester, NH

18310
Concord Electronics
New York, NY

18324
Signetics Corp.
Sacramento, CA

18377
Parlex Corp.
Methuen, MA

18520
Sharp Electronics Corp.
Paramus, NJ

18542
Wabash Inc.
Wabash Relay & Electronics Div.
Wabash, IN

18565
Chomerics Inc.
Woburn, MA

18612
Vishay Intertechnology Inc.
Vishay Resistor Products Group
Malvern, PA

18632
Norton-Chemplast
Santa Monica, CA

18677
Scanbe Mfg. Co.
Div. of Zero Corp.
El Monte, CA

18736
Voltronics Corp.
East Hanover, NJ

18786
Micro-Power
Long Island City, NY

18927
GTE Products Corp.
Precision Material Products
Business Parts Div.
Titusville,PA

19080
Robinson Electronics Inc.
San Luis Obispo, CA

19112
Garry Corp.
Langhorne, PA

19315
Bendix Corp., The
Navigation & Control Group
Terboro, NJ

19451
Perine Machine Tool Corp.
Kent, WA

19482
Delta Electronics
Alexandria, VA

19613
MN Mining & Mfg. Co.
Textool Products Dept.
Electronic Product Div.
Irving, TX

19647
Caddock Electronics Inc.
Riverside, CA

19701
Mepco/Centralab Inc.
A N. American Philips Co.
Mineral Wells, TX

2B178
Wire Products
Cleveland, OH

2K262
Boyd Corporation
Portland, OR

2Y384
North American Philips Lighting Corp.
Van Wert, OH

20584
Enochs Mfg. Inc.
INpolis, IN

20891
Cosar Corp.
Dallas, TX

21317
Electronics Applications Co.
El Monte, CA

21604
Buckeye Stamping Co.
Columbus, OH

21845
Solitron Devices Inc.
Semiconductor Group
Rivera Beach, FL

21847
Aertech
Now TRW Microwave Inc.
Sunnyvale, CA

21962
Vectron Corp.
Replaced by: S.W. Electronics

22526
DuPont, EI DeNemours & Co. Inc.
DuPont Connector Systems
Advanced Products Div.
New Cumberland, PA

22626
Micro Semiconductor
(Now 14552)

22670
GM Nameplate
Seattle, WA

22767
ITT Semiconductors
Palo Alto, CA

22784
Palmer Inc.
Cleveland, OH

23050
Product Comp. Corp.
Mount Vernon, NY

23223
CTS Microelectronics
Lafayette, NY

23237
I.R.C., Inc.
Microcircuits Divison
Philadelphia, PA

23302
S.W. Electronics & Mfg. Corp.
Cherry Hill, NJ

23730
Mark Eyelet and Stamping Inc.
Wolcott, CT

23732
Tracor Applied Sciences Inc.
Rockville, MD

23880
Stanford Applied Engineering
Santa Clara, CA

23936
William J. Purdy Co.
Pamotor Div.
Burlingame, CA

24347
Penn Engineering Co.
S. El Monte, CA

24355
Analog Devices Inc.
Norwood, MA

24444
General Semiconductor
Industries, Inc.
Tempe, AZ

24546
Bradford Electronics
Bradford, PA

24618
Transcon Mfg.
Now: D.J. Associates Inc.

24655
Genrad Inc.
(Replaced General Radio 05173)
Concord, MA

24759
Lenox-Fugle Electronics Inc.
South Plainfield, NJ

24796
AMF Inc.
Potter & Brumfield Div.
San Juan Capistrano, CA

24931
Specialty Connector Co.
Greenwood, IN

24995
ECS
Grants Pass, OR

25088
Siemen Corp.
Isilen, NJ

25099
Cascade Gasket
Kent, WA

25403
Amperex Electronic Corp.
Semiconductor & Micro-Circuit Div.
Slatersville, RI

25435
Moldtronics, Inc
Downers Grove, IL

25706
Daburn Electronic & Cable Corp.
Norwood, NJ

26402
Lumex,Inc.
Bayshore, NY

26629
Frequency Sources Inc.
Sources Div.
Chelmsford, MA

26806
American Zettler Inc.
Irvine, CA

27014
National Semiconductor Corp.
Santa Clara, CA

27167
Corning Glass Works Corning
Electronics
Wilmington, NC

27264
Molex Inc.
Lisle, IL

27440
Industrial Screw Products
Los Angeles, CA

27494
Staffall, Inc.
Providence, RI

27745
Associated Spring Barnes Group Inc.
Syracuse, NY

27918
Component Parts Corp.
Bellmore, NY

27956
Relcom (Now 14482)

28175
Alpha Metals
Chicago, IL

28198
Positronic Industries
Springfield, MO

28213
MN Mining & Mfg. Co.
Consumer Products Div.
3M Center
Saint Paul, MN

28309
Kaiser
Minette,AL.

28425
Serv-O-Link
Euless, TX

28478
Deltrol Corporation
Deltrol Controls Div.
Milwaukee, WI

28480
Hewlett Packard Co.
Corporate HQ
Palo Alto, CA

28484
Emerson Electric Co.
Gearmaster Div.
McHenry, IL

28520
Heyco Molded Products
Kenilworth, NJ

28932
Lumax Industrials, Inc
Altoona, PA

29083
Monsanto Co.
Santa Clara, CA

29604
Stackpole Components Co.
Raleith, NC

29907
Omega Engineering Inc.
Stamford, CT

3D536
Aimsco Inc.
Seattle, WA

30035
Jolo Industries Inc.
Garden Grove, CA

30045
Solid Power Corp.
Farmingdale, NY

30146
Symbex Corp.
Painesville, OH

30148
AB Enterprise Inc.
Ahoskie, NC

30161
Aavid Engineering Inc.
Laconia, NH

30315
Itron Corp.
San Diego, CA

30323
IL Tool Works Inc.
Chicago, IL

30800
General Instrument Corp.
Capacitor Div.
Hicksville, NY

30838
Fastec
Chicago,ILL

31019
Solid State Scientific Inc.
Willow Grove, PA

31091
Alpha Industries Inc.
Microelectronics Div.
Hatfield, PA

31323
Metro Supply Company
Sacramento, CA

31433
Kemet Electonics Corp.
Simpsonville, NC

31448
Army Safeguard Logistics Command
Huntsville, AL

31471
Gould Inc
Semiconductor Div
Santa Clara, CA

31522
Metal Masters Inc.
Baldwin, MS

31746
Cannon Electric
Woodbury, TN

31827
Budwig
Ramona, CA

31918
ITT-Schadow
Eden Prairie, MN

32293
Intersil
Cupertino, CA

32539
Mura Corp.
Westbury, Long Island, N.Y.

32559
Bivar
Santa Ana, CA

32719
Siltronics
Santa Ana, CA

32767
Griffith Plastics Corp.
Burlingame, CA

32879
Advanced Mechanical Components
Northridge, CA

32897
Murata Erie North America Inc.
Carlisle Operations
Carlisle, Pennsylvania

32997
Bourns Inc.
Trimpot Div.
Riverside, CA

33025
M/A ComOmni Spectra, Inc. (Replacing Omni Spectra)
Microwave Subsystems Div.
Tempe, AZ

33096
CO Crystal Corp.
Loveland, CO

33173
General Electric Co.
Owensboro, KY

33246
Epoxy Technology Inc.
Billerica, MA

33292
Pioneer Sterilized Wiping Cloth Co.
Portland, OR

33297
NEC Electronics USA Inc.
Electronic Arrays Inc. Div.
Mountain View, CA

33919
Nortek Inc.
Cranston, RI

34114
Oak Industries
Rancho Bernardo, CA

34263
CTS Electronics Corp.
Brownsville,TX

34333
Silicon General Inc.
Garden Grove, CA

34335
Advanced Micro Devices (AMD)
Sunnyvale, CA

34359
MN Mining & Mfg. Co.
Commercial Office Supply Div.
Saint Paul, MN

34371
Harris Corp.
Harris Semiconductor
Products Group
Melbourne, FL

34576
Rockwell International Corp.
Newport Beach, CA

34641
Instrument Specialties
Euless, TX

34649
Intel Corp.
Santa Clara, CA

34802
Electromotive Inc.
Kenilworth, NJ

34848
Hartwell Special Products
Placentia, CA

35009
Renfrew Electric Co. Ltd.
IRC Div.
Toronto, Ontario, Canada

35986
Amrad
Melrose Park, IL

36665
Mitel Corp.
Kanata, Ontario, Canada

36701
Van Waters & Rogers
Valley Field, Quebec, Canada

37942
Mallory Capacitor Corp.
Sub of Emhart Industries
INpolis, IN

39003
Maxim Industries
Middleboro, MA

4F434
Plastic Sales
Los Angeles, CA

40402
Roderstein Electronics Inc.
Statesville, NC

42498
National Radio
Melrose, MA

43543
Nytronics Inc.(Now 53342)

43744
Panasonic Industrial Co.
San Antonio, TX

43791
Datron Systems
Wilkes Barre, PA

44655
Ohmite Mfg. Co.
Skokie, IL

47001
Lumberg Inc.
Richmond, VA

47379
ISOCOM
Campbell, CA

49569
IDT (International Development & Trade)
Dallas, TX

49671
RCA Corp.
New York, NY

49956
Raytheon Company
Executive Offices
Lexington, MA

5D590
Mostek Corp.
Replaced by: SGS Thompson Microelectronics

5F520
Panel Components Corp.
Santa Rosa, CA

5P575
Nobel Electronics
Suffern, NY

5W664
NDK
Div. of Nihon Dempa Kogyo LTD
Lynchburg, VA

Federal Supply Codes for Manufacturers (cont)

5U802
Dennison Mfg. Co.
Framingham, MA

50088
SGS - Thomson Microelectronics Inc.
Carrollton, TX

50120
Eagle-Picher Industries Inc.
Electronics Div.
CO Springs, CO

50157
Midwest Components Inc.
Muskegon, MS

50356
Teac Corp. of America
Industrial Products Div
Montebello, CA

50364
MMI, Inc.(Monolithic Memories Inc)
Military Products Div.
Santa Clara, CA

50472
Metal Masters, Inc.
City of Industry, CA

50541
Hypertronics Corp.
Hudson, MA

50558
Electronic Concepts, Inc.
Eatontown, NJ

50579
Litronix Inc.
Cupertino, CA

50891
Semiconductor Technology
Stuart, FL

50934
Tran-Tec Corp
Columbus, NE

51167
Aries Electronics Inc.
Frenchtown, NJ

51284
Mos Technology
Norristown, PA

51249
Heyman Mfg. Co.
Cleveland, OH

51372
Verbatim Corp.
Sunnyvale, CA

51398
MUPAC Corp.
Brockton, MA

51406
Murata Erie, No. America Inc.
(Also see 72982)
Marietta, GA

51499
Amtron Corp.
Boston, MA

51506
Accurate Screw Machine Co.
(ASMCO) Nutley, NJ

51605
CODI Semiconductor Inc.
Kenilworth, NJ

51642
Centre Engineering Inc.
State College, PA

51705
ICO/Rally
Palo alto, CA

51791
Statek Corp.
Orange, CA

51984
NEC America Inc.
Falls Church, VA

52063
Exar Integrated Systems
Sunnyvale, CA

52072
Circuit Assembly Corp.
Irvine, CA

52152
MN Mining & Mfg.
Saint Paul, MN

52333
API Electronics
Haugpauge,Long Island,NY

52361
Communication Systems
Piscataway, NJ

52500
Amphenol, RF Operations
Burlington, MA

52525
Space-Lok Inc.
Lerco Div.
Burbank, CA

52531
Hitachi Magnetics
Edmore, MO

52745
Timco
Los Angeles, CA

52763
Stettner-Electronics Inc.
Chattanooga, TN

52769
Sprague-Goodman Electronics Inc.
Garden City Park, NY

52771
Moniterm Corp.
Amatrom Div.
Santa Clara, CA

52840
Western Digital Corp.
Costa Mesa, CA

53021
Sangamo Weston Inc.
(See 06141)

53036
Textool Co.
Houston, TX

53184
Xciton Corp.
Lathan, NY

53217
Technical Wire Products Inc.
Santa Barbara, CA

53342
Opt Industries Inc.
Phillipsburg, NJ

53673
Thompson CSF Components Corp.
(Semiconductor Div)
Conaga Park, CA

53718
Airmold/W. R. Grese & Co.
Roanoke Rapids, NC

53848
Standard Microsystems
Hauppauge, NY

53894
AHAM Inc.
RanchoCA, CA

53944
Glow-Lite
Pauls Valley, OK

54178
Plasmetex Industries Inc.
San Marcos, CA

54294
Shallcross Inc.
Smithfield, NC

54453
Sullins Electronic Corp.
San Marcos, CA

54473
Matsushita Electric Corp.
(Panasonic)
Secaucus, NJ

54492
Cinch Clamp Co., Inc.
Santa Rosa, CA

54583
TDK
Garden City, NY

54590
RCA Corp
Distribution & Special Products
Cherry Hill, NY

54869
Piher International Corp.
Arlington Heights, IL

54937
DeYoung Mfg.
Bellevue, WA

54590
RCA Corp.
Electronic Components Div.
Cherry Hill, NJ

55026
American Gage & Machine Co.
Simpson Electric Co. Div.
Elgin, IL

55112
Plessey Capacitors Inc.
(Now 60935)

55261
LSI Computer Systems Inc.
Melville, NY

55285
Bercquist Co.
Minneapolis, MN

55322
Samtech Inc.
New Albany, IN

55408
STI-CO Industries Co
Buffalo, NY

55464
Central Semiconductor Corp.
Hauppauge, NY

55557
Microwave Diode Corp.
W.Stewarstown, NH

55566
R A F Electronic Hardware Inc.
Seymour, CT

55576
Synertek
Santa Clara, CA

55680
Nichicon/America/Corp.
Schaumburg, IL

55943
D J Associates, Inc
(Replaced Transcon Mfg.-24618)
Fort Smith, AZ

56282
Utek Systems Inc.
Olathe, KS

56289
Sprague Electric Co.
North Adams, MA

56365
Square D Co.
Corporate Offices
Palatine, IL

56375
WESCORP
Div. Dal Industries Inc
Mountain View, CA

56481
Shugart Associates
Sub of Xerox Corp.
Sunnyvale, CA

56637
RCD Components Inc.
Manchester, NH

56708
Zilog Inc.
Campbell, CA

56856
Varistor Corp. of TN
Sevierville, TN

56880
Magnetics Inc.
Baltimore, MD

57026
Endicott Coil Co. Inc.
Binghamton, NY

57053
Gates Energy Products
Denver, CO

57170
Cambridge Thermionic
Cambridge, MA
Replaced by:
71279
Interconnection Products Inc.

57668
R-ohm Corp
Irvine, CA

57962
SGS - Thomson Microelectronics Inc
Montgomeryville, PA

58014
Hitachi Magnalock Corp.
(Now 12581)

58104
Simco
Atlanta, GA

58364
BYCAP Inc.
Chicago, IL

58451
Precision Lamp
Cotat, CA

58474
Superior Electric Co.
Bristol, CT

58614
Communications Instruments Inc.
Fairview, NC

59124
KOA-Speer Electronics Inc.
Bradford, PA

59422
Holmberg Electronics
Irvine, CA

59610
Souriau Inc
Valencia, CA

59635
HV Component Associates
Howell, NJ

59640
Supertex Inc.
Sunnyvale, CA

59660
Tusonix Inc.
Tucson, AZ

59730
Thomas and Betts Corp.
IA City, IA

59831
Semtronics Corp.
Watchung, NJ

6I1053:
American Components Inc.
an Insilco Co. RPC Div.
Hayesville, NC

6L611
Allen, Robert G. Inc.
Van Nuys, CA

6U850
Burgess Switch Co., Inc
Northbrook, IL

6U095
AMD Enterprises, Inc.
Roswell, GA

6X403
SGS/ATES Semiconductor Corp.
INpolis, IN

6Y440
Micron Technology Inc.
Boise, ID

60046
Power Dynamics Inc
West Orange, NJ

60197
Precicontact Inc.
Langhorne, PA

60386
Squires Electronics Inc
Cornelius, OR

60395
Xicor Inc.
Milpitas, CA

60399
Torin Engineered Blowers
Div. of Clevepak Corp.
Torrington, CT

60496
Micrel Inc.
Sunnyvale, CA

60705
Cera-Mite Corp.
(formerly Sprague)
Grafton, WI

60911
Inmos Corp.
CO Springs, CO

60935
Westlake Capacitor Inc.
Tantalum Div.
Greencastle, IN

60958
ACIC
Intercomp Wire & Cable Div.
Hayesville, NC

61271
Fujitsu Microelectronics Inc
San Jose, CA

61394
SEEQ Technology Inc.
San Jose, CA

61429
Fox Electronics
Cape Coral, FL

61529
Aromat Corp.
New Providence, NJ

61752
IR-ONICS Inc
Warwick, RI

61772
Integrated Device Technology
Santa Clara, CA

61802
Toshiba
Houston, TX

61857
SAN-O Industrial Corp.
Bohemia, Long Island, NY

61935
Schurter Inc.
Petaluma, CA

62351
Apple Rubber
Lancaster, NY

62643
United Chemicon
Rosemont, IL

62712
Seiko Instruments
Torrance, CA

62793
Lear Siegler Inc.
Energy Products Div.
Santa Ana, CA

63743
Ward Leonard Electric Co.Inc.
Mount Vernon, NY

64154
Lamb Industries
Portland, OR

64155
Linear Technology
Milpitas, CA

64537
KDI Electronics
Whippany, NJ

64782
Precision Control Mfg. Inc.
Bellevue, WA

64834
West M G Co.
San Francisco, CA

64961
Electronic Hardware LTD
North Hollywood, CA

65092
Sangamo Weston Inc.
Weston Instruments Div.
Newark, NJ

65786
Cypress Semi
San Jose, CA

65940
Rohm Corp & Whatney
Irvine, CA

65964
Evox Inc.
Bannockburn, IL

66150
Entron Inc.
Winslow Teltronics Div.
Glendale, NY

66302
VLSI Technology Inc.
San Jose, CA

66419
Exel
San Jose, CA

66450
Dyna-Tech Electronics, Inc
Walled Lake, MI

66608
Bering Industries
Freemont, CA

66891
BKC International Electronics
Lawrence, MA

66958
SGS Semiconductor Corp.
Phoenix, AZ

66967
Powerex Inc
Auburn, NY

67183
Altera
Santa Clara, CA

68919
WIMA
% Harry Levinson Co.
Seattle, WA

7F361
Richmond-Division of Dixico
% Zellerbach Paper Co.
Seattle, WA

7F844
Moore Business Forms, Inc
Seattle, WA

7G902
Textron Inc.
Camcar Div.
Rockford, IL

7J395
Universal Plastics
Welshpool, WA

7J696
AMD Plastics
East Lake, OH

7K354
Omni Spectra Inc
Los Altos, CA

7Z884
ALPS
Seattle, WA

7X634
Duracell USA
Div. of Dart & Kraft Inc.
Valdese, NC

70290
Almetal Universal Joint Co.
Cleveland, OH

70485
Atlantic India Rubber Works Inc.
Chicago, IL

70563
Amperite Company
Union City, NJ

70903
Cooper-Belden Corp.
Geneva, IL

71002
Bimbach Co. Inc.
Farmingdale, NY

71034
Bliley Electric Co.
Erie, PA

71183
Westinghouse Electric Corp.
Bryant Div.
Bridgeport, CT

71279
Interconnection Products Inc.
Formerly Midland-Ross Cambion Div.
Santa Ana, CA

71400
Bussman Manufacturing
Div. McGraw-Edison Co.
St. Louis, MO

71450
CTS Corp.
Elkhart, IN

71468
ITT Cannon Div. of ITT
Fountain Valley, CA

71482
General Instrument Corp.
Clare Div.
Chicago, IL

71590
Mepco/Centralab
A North American Philips Co.
Fort Dodge, IA

71707
Coto Corp.
Providence, RI

71744
General Instrument Corp.
Lamp Div/Worldwide
Chicago, IL

71785
TRW Inc.
Cinch Connector Div.
Elk Grove Village, IL

71984
Dow Corning Corp.
Midland, MI

72005
AMAX Specialty Metals Corp.
Newark, NJ

72136
Electro Motive Mfg. Corp.
Florence, NC

72228
AMCA International Corp.
Continental Screw Div.
New Bedford, MA

72259
Nytronics Inc.
New York, NY

72619
Amperex Electronic Corp.
Dialight Div.
Brooklyn, NY

72653
G C Electronics Co.
Div. of Hydrometals Inc.
Rockford, IL

72794
Dzus Fastner Co. Inc.
West Islip, NY

72928
Gulton Industries Inc.
Gudeman Div.
Chicago, IL

72962
Elastic Stop Nut
Div. of Harrard Industries
Union, NJ

72982
Erie Specialty Products, Inc
Formerly: Murata Erie
Erie, PA

73138
Beckman Industrial corp.
Helipot Div.
Fullerton, CA

73168
Fenwal Inc.
Ashland, MA

73293
Hughes Aircraft Co.
Electron Dynamics Div.
Torrance, CA

73445
Amperex Electronic Corp.
Hicksville, NY

73559
Carlingswitch Inc.
Hartford, CT

73586
Circle F Industries
Trenton, NJ

73734
Federal Screw Products Inc.
Chicago, IL

73743
Fischer Special Mfg. Co.
Cold Spring, KY

73893
Microdot
Mt. Clemens, MS

73899
JFD Electronic Components
Div. of Murata Erie
Oceanside, NY

73905
FL Industries Inc.
San Jose, CA

73949
Guardian Electric Mfg. Co.
Chicago, IL

74199
Quam Nichols Co.
Chicago, IL

74217
Radio Switch Co.
Marlboro, NJ

74306
Piezo Crystal Co.
Div. of PPA Industries Inc.
Carlisle, PA

74445
Holo-Krome Co.
Elmwood, CT

74542
Hoyt Elect.Instr. Works Inc.
Penacook, NH

74840
IL Capacitor Inc.
Lincolnwood, IL

74970
Johnson EF Co.
Waseca, MN

75042
TRW Inc.
IRC Fixed Resistors
Philadelphia, PA

75297
Kester Solder Div.
Litton Systems, Inc
Des Plaines, IL

75376
Kurz-Kasch Inc.
Dayton, OH

75378
CTS Knights Inc.
Sandwich, IL

75382
Kulka Electric Corp.
(Now 83330)
Mount Vernon, NY

75569
Performance Semiconductor Corp.
Sunnyvale, CA

75915
Littelfuse Tracor
(Formerly: Tracor-Littelfuse)
Des Plaines, IL

76854
Oak Switch Systems Inc.
Crystal Lake, IL

77122
TRW Assemblies & Fasteners Group
Fastener Div.
Moutainside, NJ

77342
AMF Inc.
Potter & Brumfield Div.
Princeton, IN

77542
Ray-O-Vac Corp
Madison, WI

77638
General Instrument Corp.
Rectifier Div.
Brooklyn, NY

77900
Shakeproof Lock Washer Co.
(Now 78189)

77969
Rubbercraft Corp. of CA Ltd.
Torrance, CA

78189
IL Tool Works Inc.
Shakeproof Div.
Elgin, IL

78277
Sigma Instruments Inc.
South Braintree, MA

78290
Struthers Dunn Inc.
Pitman, NJ

78553
Eaton Corp.
Engineered Fastener Div.
Cleveland, OH

78592
Stoeger Industries
South Hackensack, NJ

79497
Western Rubber Co.
Goshen, IN

79727
C - W Industries
Southampton, PA

79963
Zierick Mfg. Corp.
Mount Kisco, NY

8C798
Ken-Tronics, Inc.
Milan, IL

8D528
Baumgartens
Atlanta, GA

8F330
Eaton Corp.
Cutler Hammer Product Sales Office
Mountain View, CA

8T100
Tellabs Inc.
Naperville, IL

80009
Tektronix
Beaverton, OR

80031
Mepco/Electra Inc.
Morristown, NJ

80032
Ford Aerospace &
Communications Corp.
Western Development
Laboratories Div.
Palo Alto, CA

80145
LFE Corp.
Process Control Div.
Clinton, OH

80183
Sprague Products
(Now 56289)

80294
Bourns Instruments Inc.
Riverside, CA

80583
Hammerlund Mfg. Co. Inc.
Paramus, NJ

80640
Computer Products Inc.
Stevens-Arnold Div.
South Boston, MA

81073
Grayhill Inc.
La Grange, IL

81312
Litton Systems Inc.
Winchester Electronics Div.
Watertown, CT

81439
Therm-O-Disc Inc.
Mansfield, OH

81483
International Rectifier Corp.
Los Angeles, CA

81590
Korry Electronics Inc.
Seattle, WA

81741
Chicago Lock Co.
Chicago, IL

82227
Airpax Corp.
Cheshire Div.
Cheshire, CT

82240
Simmons Fastner Corp.
Albany, NY

82305
Palmer Electronics Corp.
South Gate, CA

82389
Switchcraft Inc.
Sub of Raytheon Co.
Chicago, IL

82415
Airpax Corp
Frederick Div.
Frederick, MD

82872
Roanwell Corp.
New York, NY

82877
Rotron Inc.
Custom Div.
Woodstock, NY

82879
ITT
Royal Electric Div.
Pawtucket, RI

83003
Varo Inc.
Garland, TX

83014
Hartwell Corp.
Placentia, CA

83055
Signalite Fuse Co.
(Now 71744)

83058
TRW Assemblies & Fasteners Group
Fasteners Div.
Cambridge, MA

83259
Parker-Hannifin Corp.
O-Seal Div.
Culver City, CA

83298
Bendix Corp.
Electric & Fluid Power Div.
Eatonville, NJ

83315
Hubbell Corp.
Mundelein, IL

83330
Kulka Smith Inc.
A North American Philips Co.
Manasquan, NJ

83478
Rubbercraft Corp. of America
West Haven, CT

83553
Associated Spring Barnes Group
Gardena, CA

83740
Union Carbide Corp.
Battery Products Div.
Danbury, CT

84171
Arco Electronics
Commack, NY

84411
American Shizuki
TRW Capacitors Div.
Ogallala, NE

84613
FIC Corp.
Rockville, MD

84682
Essex Group Inc.
Peabody, MA

84830
Lee Spring Co. Inc
Brooklyn, NY

85367
Bearing Distributing Co.
San Fransisco, CA

85372
Bearing Sales Co.
Los Angeles, CA

85480
W. H. Brady Co.
Industrial Product
Milwaukee, WI

85840
Brady WH Co
Industrial Products Div
Milwaukee, WI

85932
Electro Film Inc.
Valencia, CA

86577
Precision Metal Products Co.
Peabody, MA

86684
Radio Corp. of America
(Now 54590)

86928
Seastrom Mfg. Co. Inc.
Glendale, CA

87034
Illuminated Products Inc.
(Now 76854)

87516
Standard Crystal
KS City, KS

88044
Aeronautical Standards Group
Dept. of Navy & Air Force

88219
GNB Inc.
Industrial Battery Div.
Langhorne, PA

88245
Winchester Electronics
Litton Systems-Useco Div.
Van Nuys, CA

88486
Triangle PWC Inc.
Jewitt City, CT

88690
Essex Group Inc.
Wire Assembly Div.
Dearborn, MI

88786
Atlantic India Rubber Co.
Goshen, IN

88978
Philips (Now Fluke)
Mahwah, NJ

89020
Amerace Corp.
Buchanan Crimptool Products Div.
Union, NJ

89265
Potter-Brumfield
(See 77342)

89462
Waldes Truarc, Inc.
Long Island, NY

89536
John Fluke Mfg. Co., Inc.
Everett, WA

89597
Fredericks Co.
Huntingdon Valley, PA

89709
Bunker Ramo-Eltra Corp.
Amphenol Div.
Broadview, IL

89730
General Electric
Lamp Div.
Newark, NJ

9R216
Data Composition Svc, Inc
Laurel, MD

9S171
Port Plastics
Tukwila, WA

9W423
Amatom
El Mont, CA

90201
Mallory Capacitor Co.
Sub of Emhart Industries Inc.
Indianapolis, IN

90215
Best Stamp & Mfg. Co.
KS City, MO

90303
Duracell Inc.
Technical Sales & Marketing
Bethel, CT

91094
Essex Group Inc.
Suflex/IWP Div.
Newmarket, NH

91247
IL Transformer Co.
Chicago, IL

91293
Johanson Mfg. Co.
Boonton, NJ

91462
Alpha Industries Inc.
Logansport, IN

91502
Associated Machine
Santa Clara, CA

91506
Augat Alcoswitch
N. Andover, MA

91507
Froeliger Machine Tool Co.
Stockton, CA

91637
Dale Electronics Inc.
Columbus, NE

91662
Elco Corp.
A Gulf Westem Mfg. Co.
Connector Div.
Huntingdon, PA

91737
ITT Cannon/Gremar
(Now 08718)

91802
Industrial Devices Inc.
Edgewater, NJ

91833
Keystone Electronics Corp.
NY, NY

91836
King's Electronics Co. Inc.
Tuckahoe, NY

91929
Honeywell Inc.
Micro Switch Div.
Freeport, IL

91934
Miller Electric Co.
Woonsocket, RI

91967
National Tel-Tronics
Div. of electro Audio Dynamics Inc
Meadville, PA

91984
Maida Development Co.
Hampton, VA

91985
Norwalk Valve Co.
S. Norwalk, CT

92218
Wakefield Corp., The
Wakefield, ME

92527
VTC Inc.
Bloomington, MN

92607
Tensolite Co.
Div. of Carlisle Corp.
Buchanan, NY

92914
Alpha Wire Corp.
Elizabeth, NJ

93332
Sylvania Electric Products
Semiconductor Products Div.
Woburn, MA

94144
Raytheon Co.
Microwave & Power Tube Div.
Quincy, MA

94222
Southco Inc.
Concordville, PA

94988
Wagner Electric Corp.
Sub of Mcgraw-Edison Co.
Whippany, NJ

95146
Alco Electronic Products Inc.
Switch Div.
North Andover, MA

95263
Leecraft Mfg. Co.
Long Island City, NY

95275
Vitramon Inc.
Bridgeport, CT

95303
RCA Corp.
Receiving Tube Div.
Cincinnati, OH

95348
Gordo's Corp.
Bloomfield, NJ

95354
Methode Mfg. Corp.
Rolling Meadows, IL

95573
Campion Laboratories Inc.
Detroit, MI

95712
Bendix Corp.
Electrical Comp. Div.
Franklin, IN

95987
Weckesser Co. Inc.
(Now 85480)

96733
SFE Technologies
San Femando, CA

96853
Gulton Industries Inc.
Measurement & Controls Div.
Manchester, NH

96881
Thomson Industries Inc.
Port WA, NY

97464
Industrial Retainer Ring
Irvington, NJ

97525
EECO Inc.
Santa Ana, CA

97540
Whitehall Electronics Corp.
Master Mobile Mounts Div.
Fort Meyers, FL

97913
Industrial Electronic
Hardware Corp.
NY, NY

97945
Pennwalt Corp.
SS White Industrial Products
Piscataway, NJ

97966
CBS
Electronic Div.
Danvers, MA

98094
Machlett Laboratories Inc.
Santa Barbara. CA

98159
Rubber-Teck Inc.
Gardena, CA

98278
Malco A Microdot Co.
South Pasadena, CA

98291
Sealectro Corp.
BICC Electronics
Trumbill, CT

98372
Royal Industries Inc.
(Now 62793)

98388
Lear Siegler Inc.
Accurate Products Div.
San Deigo, CA

98978
IERC
(International Electronic Research Corp.)
Burbank, CA

99120
Plastic Capacitors Inc.
Chicago, IL

99217
Bell Industries Inc.
Elect. Distributor Div.
Sunnyvale, CA

99378
ATLEE of DE Inc.
N. Andover, MA

99392
Mepco/Electra Inc.
Roxboro Div.
Roxboro, NC

99515
Electron Products Inc.
Div. of American Capacitors
Duarte, CA

99779
Bunker Ramo- Eltra Corp.
Bames Div.
Lansdown, PA

99800
American Precision Industries
Delevan Div.
East Aurora, NY

99942
Mepco/Centralab
A North American Philips Co.
Milwaukee, WI

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Tel: 90 1 1435891

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Casilla de Correo 1400
Libertad 2525
Montevideo
Tel: 598-2-789015

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Coasin C.A.
Calle 9 Con Calle 4, Edif. Edinurbi
Apartado de Correos Nr-70-136
Los Ruices
Caracas 1070-A
Tel: 58 2 241-0309, 241-1248

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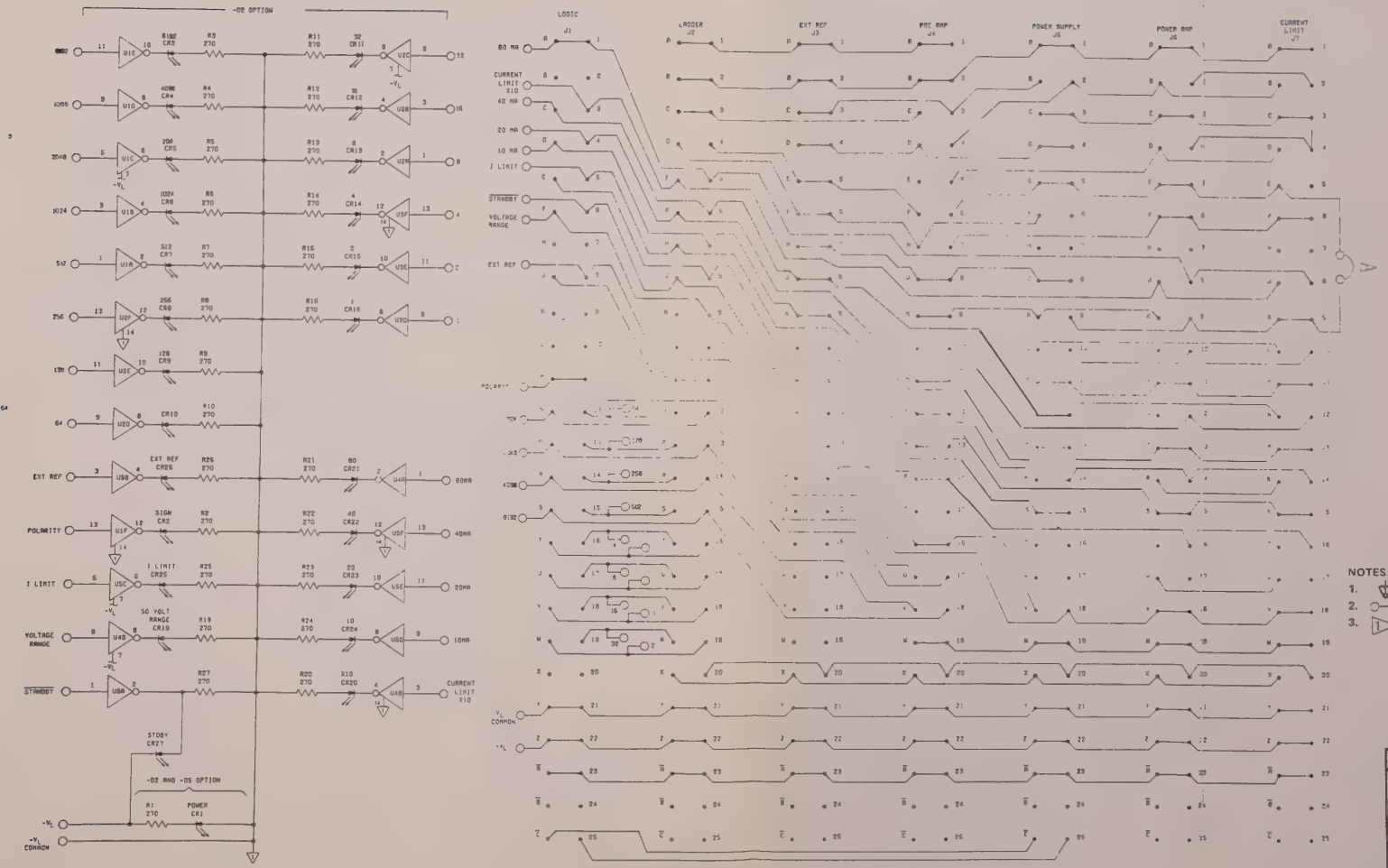
Department VSF
Service fuer FLUKE - Produkte
Oskar - Messter - Strasse 18
D-8045 Ismaning / Munich
Tel: 49 089 9605-260

Section 8
Schematic Diagrams

TITLE	DRAWING NO.
A1 Mother Board/A7 Binary Display	4265A-1011
	4265A-1013
A2 Power Supply/A10 Connector Board	4250A-1061
	4250A-1012
A3 Preamplifier	4265A-1051
A5 Option –03, External Reference	4210A-1041
A5 Binary Ladder	4216A-1031
A6 Isolated Control Logic (2 sheets)	4275A-1021
A8 Option –06, Programmable Current Limiter	4250A-1081
A9 Power Amplifier	4250A-1071



NOTES:

1. LOGIC GROUND
2. CONNECTION TO DISPLAY PCB
3. JUMPER TO BE REMOVED WHEN PROGRAMMABLE CURRENT LIMIT IS INSTALLED

FUNCTIONAL SCHEMATIC DIAGRAM

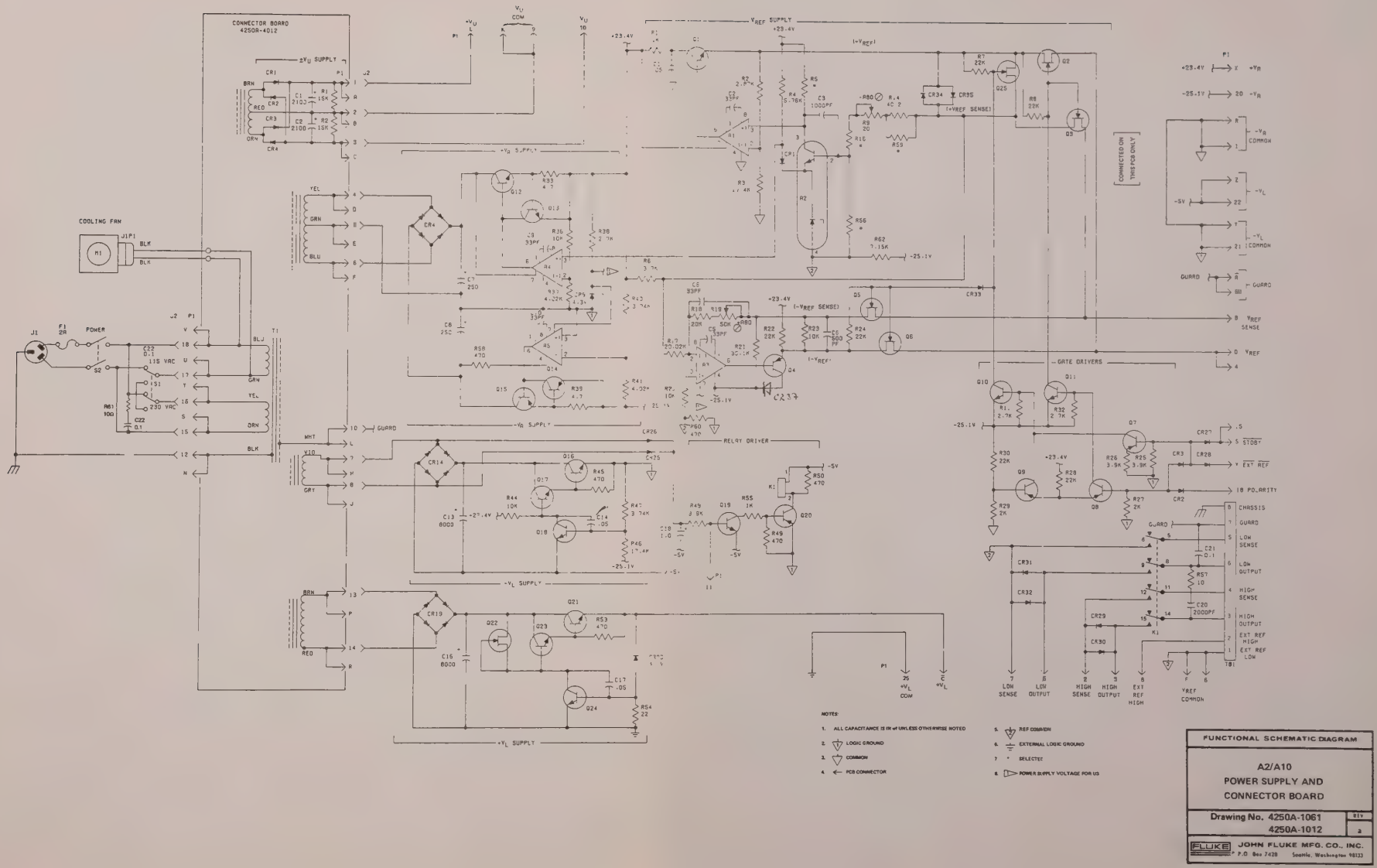
A1
MOTHER BOARD
A7
BINARY DISPLAY

1

DRAWING No. 4265A-1011
4265A-1013

REV
b

JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133



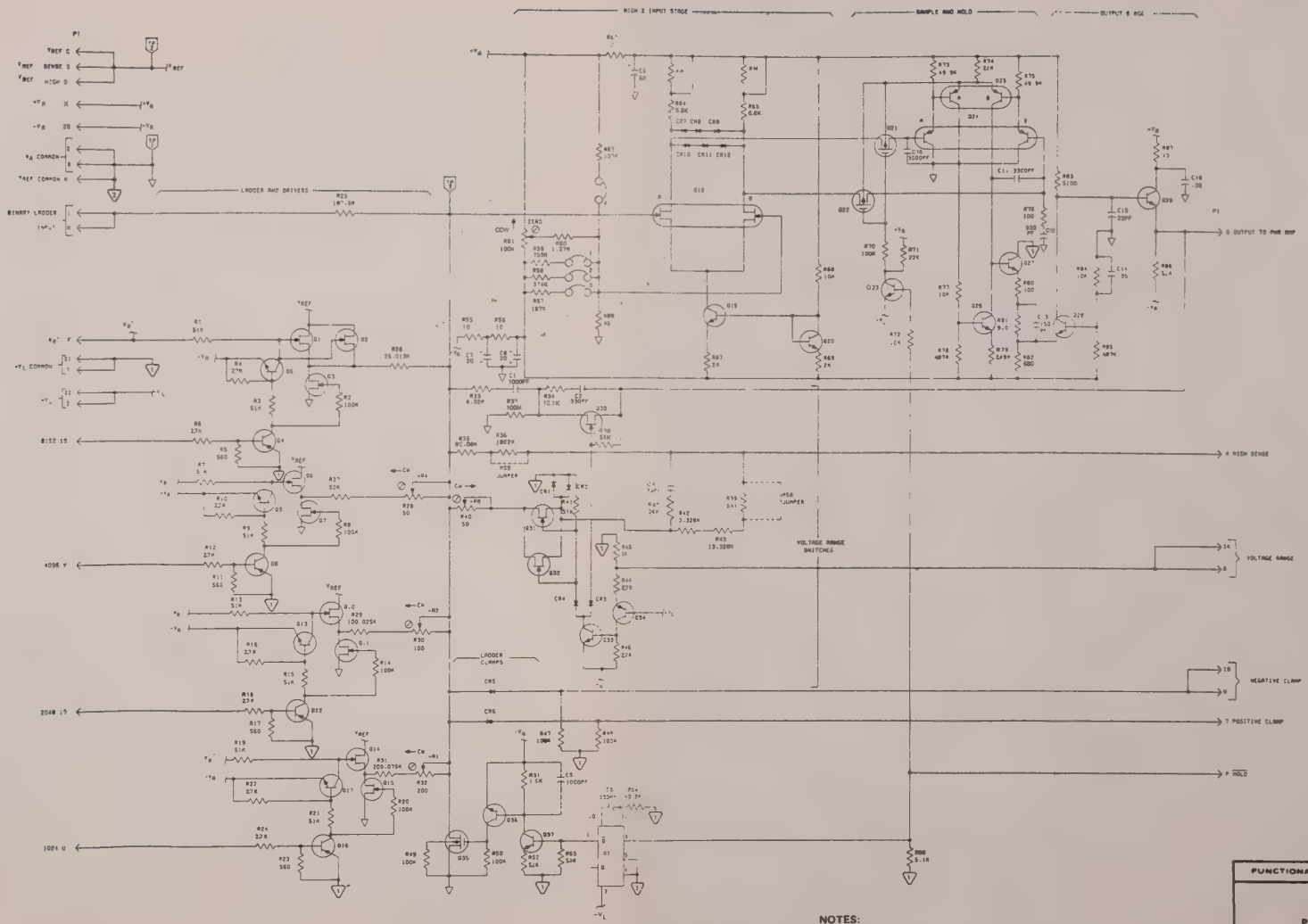
FUNCTIONAL SCHEMATIC DIAGRAM

A2/A10
POWER SUPPLY AND
CONNECTOR BOARD

Drawing No. 4250A-1061
4250A-1012

Rev a

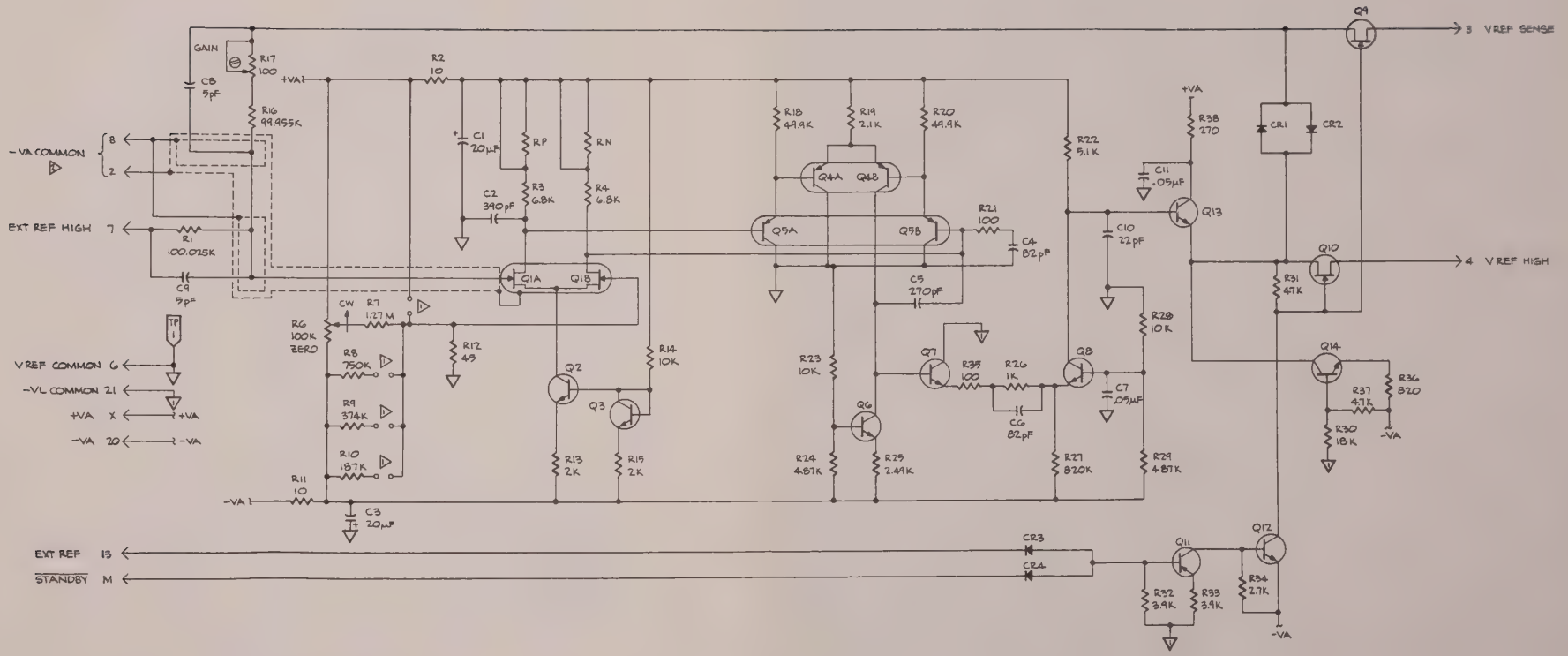
FLUKE JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133



NOTES:

1. ALL CAPACITANCE IS IN uf UNLESS OTHERWISE NOTED
2. LOGIC GROUND
3. COMMON
4. PCB CONNECTOR
5. REF COMMON

FUNCTIONAL SCHEMATIC DIAGRAM	
A3 PREAMPLIFIER	3
Drawing No. 4265A-1051	REV C
JOHN FLUKE MFG. CO., INC. P.O. Box 7428 Seattle Washington 98133	



NOTES:

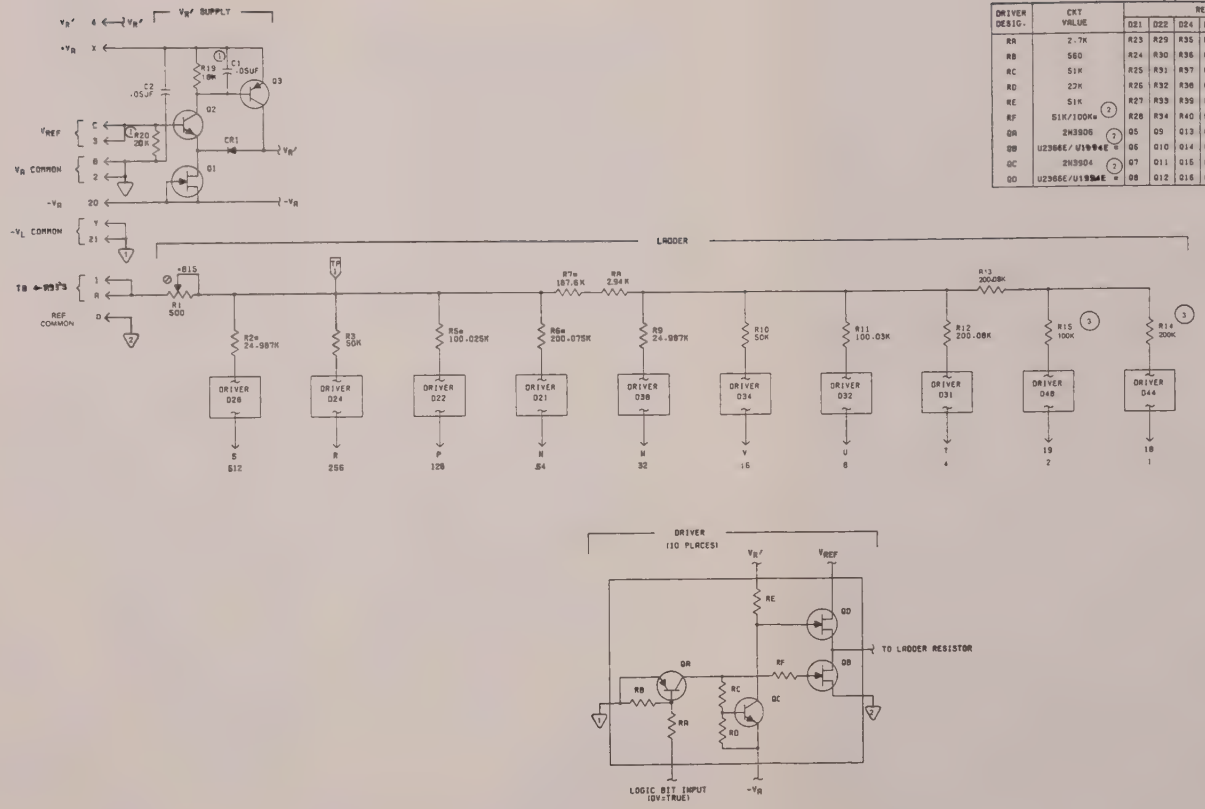
1. ALL CAPACITANCE IS IN MICROFARADS AND ALL RESISTANCE IS IN OHMS UNLESS OTHERWISE NOTED.
2. THE FOLLOWING P1 PINS ARE NOT CONNECTED: 1, 3, 8 THRU 12, 14 THRU 19, 22 THRU 25, A, C THRU F, H THRU L, N THRU W, Y, Z, AND Ā THRU Z̄.
3. ▽ LOGIC GROUND
4. ▽ COMMON
5. < PCB CONNECTOR
6. > PROGRAMMING CONNECTOR
7. INSTALL PROPER JUMPERS TO ZERO INSTRUMENT.
8. 2 AND 8 ON OPPOSITE SIDES OF PCB.

REV	DESCRIPTION
1	INITIAL ISSUE

A4 OPTION -03
EXTERNAL REFERENCE

4210A-1041

DATE MAY. 1972



DRIVER DESIG.	CKT VALUE	REFERENCE DESIGNATIONS									
		D21	D22	D24	D29	D31	D32	D34	D38	D44	D48
RA	7.7K	R23	R29	R35	R41	R47	R53	R59	R65	R83	R89
RB	560	R24	R30	R36	R42	R48	R54	R60	R66	R84	R90
RC	51K	R25	R31	R37	R43	R49	R55	R61	R67	R85	R91
RD	22K	R26	R32	R38	R44	R50	R56	R62	R68	R86	R92
RE	51K (2)	R27	R33	R39	R45	R51	R57	R63	R69	R87	R93
RF	51K/100K* (2)	R28	R34	R40	R46	R52	R58	R64	R70	R88	R94
QA	2N3906 (2)	Q5	Q9	Q13	Q17	Q21	Q25	Q29	Q33	Q45	Q49
QB	U2366E/U1994E * (2)	Q6	Q10	Q14	Q18	Q22	Q26	Q30	Q34	Q46	Q50
QC	2N3904 (2)	Q7	Q11	Q15	Q19	Q23	Q27	Q31	Q35	Q47	Q51
QD	U2366E/U1994E * (2)	Q8	Q12	Q16	Q20	Q24	Q28	Q32	Q36	Q48	Q52

CHANGES:

(1) R19 WAS 560Ω ON S/N 123 THRU 147
R20 WAS 51K ON S/N 123 THRU 147

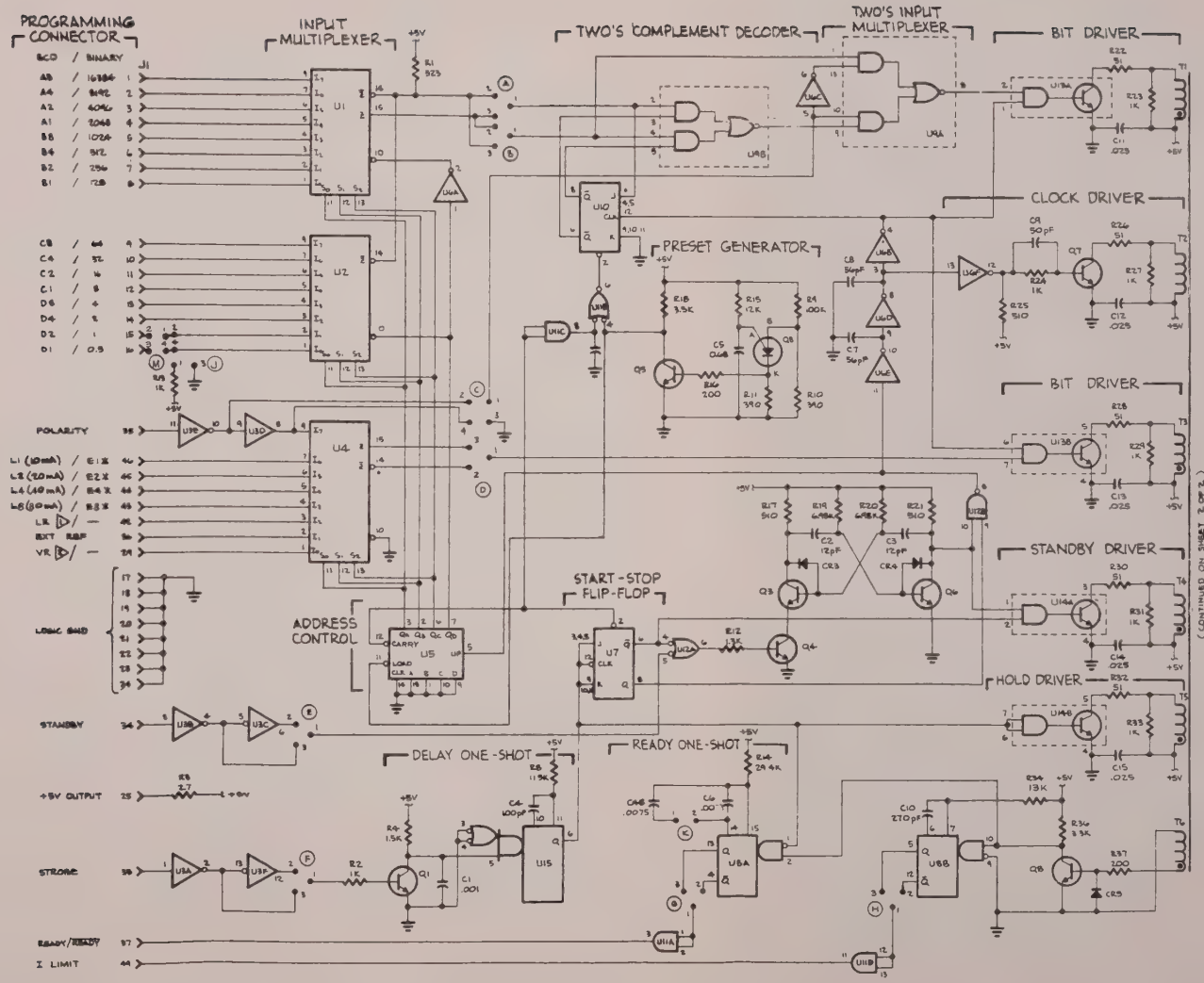
(2) FOR S/N 208 AND ON:
R88 AND R94 ARE 51K Q46, Q50, Q48, Q52 ARE U2366E

(3) R14 WAS 806K ON S/N 123 THRU 207
R15 WAS 402K ON S/N 123 THRU 207

NOTES:

1. ALL CAPACITANCE IS IN uf UNLESS OTHERWISE NOTED
2. ⏚ LOGIC GROUND
3. ⏚ COMMON
4. ⟵ PCB CONNECTOR
5. * FACTORY SELECTED
6. ⏚ REF COMMON

FUNCTIONAL SCHEMATIC DIAGRAM	
A5 BINARY LADDER	
DRAWING NO. 4216A-1031	REV b
JOHN FLUKE MFG. CO., INC. P.O. Box 7428 Seattle, Washington 98133	



LOGIC CONTROL CONFIGURATION	JUMPER POSITION												
	A	B	C	D	E	F	G	H	J	K	L	M
4210A-01	1-2	1-2	1-3	1-2	1-2	1-2	1-2	1-2	—	—	—	1-2 3-4
4210A-01*	1-3	1-3	1-3	1-3	1-3	1-3	1-3	—	—	—	—	1-2 3-4
4216A-01	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2 2-4	—	—	—	—
4216A-01*	1-3	1-3	1-4	1-3	1-3	1-3	1-3	2-4 3-4	—	—	—	—
4250A/4270A-01	1-2	1-2	1-3	1-2	1-2	1-2	1-2	—	1-2	1-2	1-2	3-4
4250A/4270A-01*	1-3	1-3	1-3	1-3	1-3	1-3	1-3	—	2-4	1-2	1-2	3-4
4265A-01	1-2	1-2	1-2	1-2	1-2	1-2	1-2	1-2 2-4	1-2	1-2	—	—
4265A-01*	1-3	1-3	1-4	1-3	1-3	1-3	1-3	2-4 3-4	1-2	1-2	—	—
4275A-01	1-2	1-2	1-2	1-2	1-2	1-2	1-2	—	1-2	1-2		1-2 3-4
4275A-01*	1-3	1-3	1-4	1-3	1-3	1-3	1-3	—	1-2	1-2		1-2 3-4

* INVERTED LOGIC LEVELS

NOTES

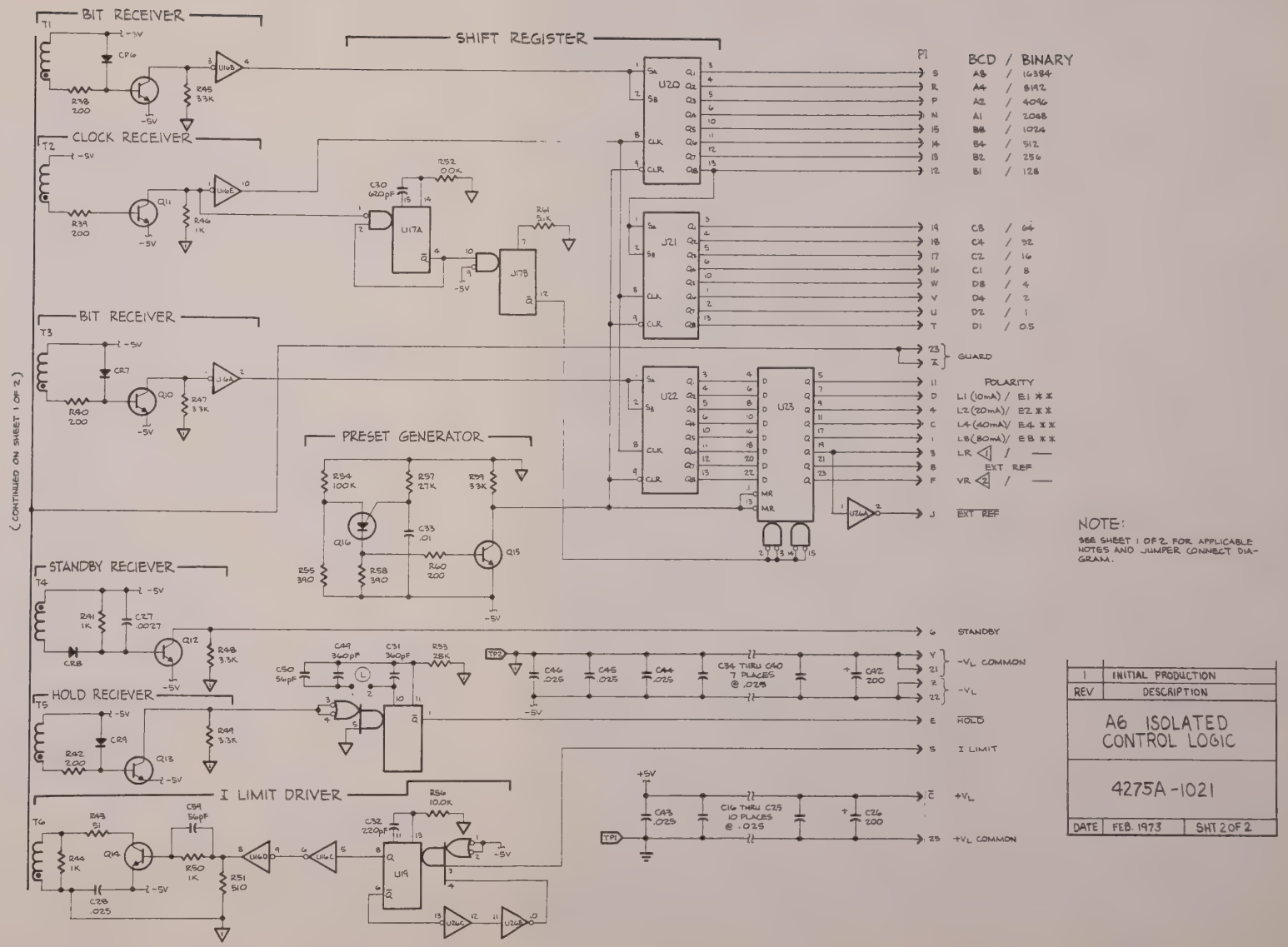
1. ALL RESISTANCE IS IN OHMS AND ALL CAPACITANCE IS IN MICROFARADS UNLESS OTHERWISE NOTED
2. EXTERNAL LOGIC GROUND
3. LOGIC GROUND
4. * 'E' DECADE INPUT WHEN AS BCD LADDER (100 μV RESOLUTION) – 07 OPTION IS USED.
5. ** SHIFT REGISTER OUTPUT WHEN AS BCD LADDER (100 μV RESOLUTION) – 07 OPTION IS USED.
6. LR (CURRENT LIMIT X10)
7. VR (VOLTAGE RANGE)
8. THE FOLLOWING P1 PINS ARE NOT CONNECTED: 2, 7, 9, 10, 20, 24, A, B, H, K, L, M, X AND Z. THE FOLLOWING J1 JACKS ARE NOT CONNECTED: 26 27 28 30 31 32 38 39 40 41 47 48 AND 50

REV	DESCRIPTION
A	(ECO'S 7435 & 7955) R34 WAS 10.10K. ADDED JUMPER POSITION CHART, REVISED ZONES C7 & A4
2	JUMPER POSITION CORRECTION
1	INITIAL PRODUCTION

A6 ISOLATED CONTROL LOGIC

4275A-1021

DATE: FEB 1973 | SHT 1 OF 2



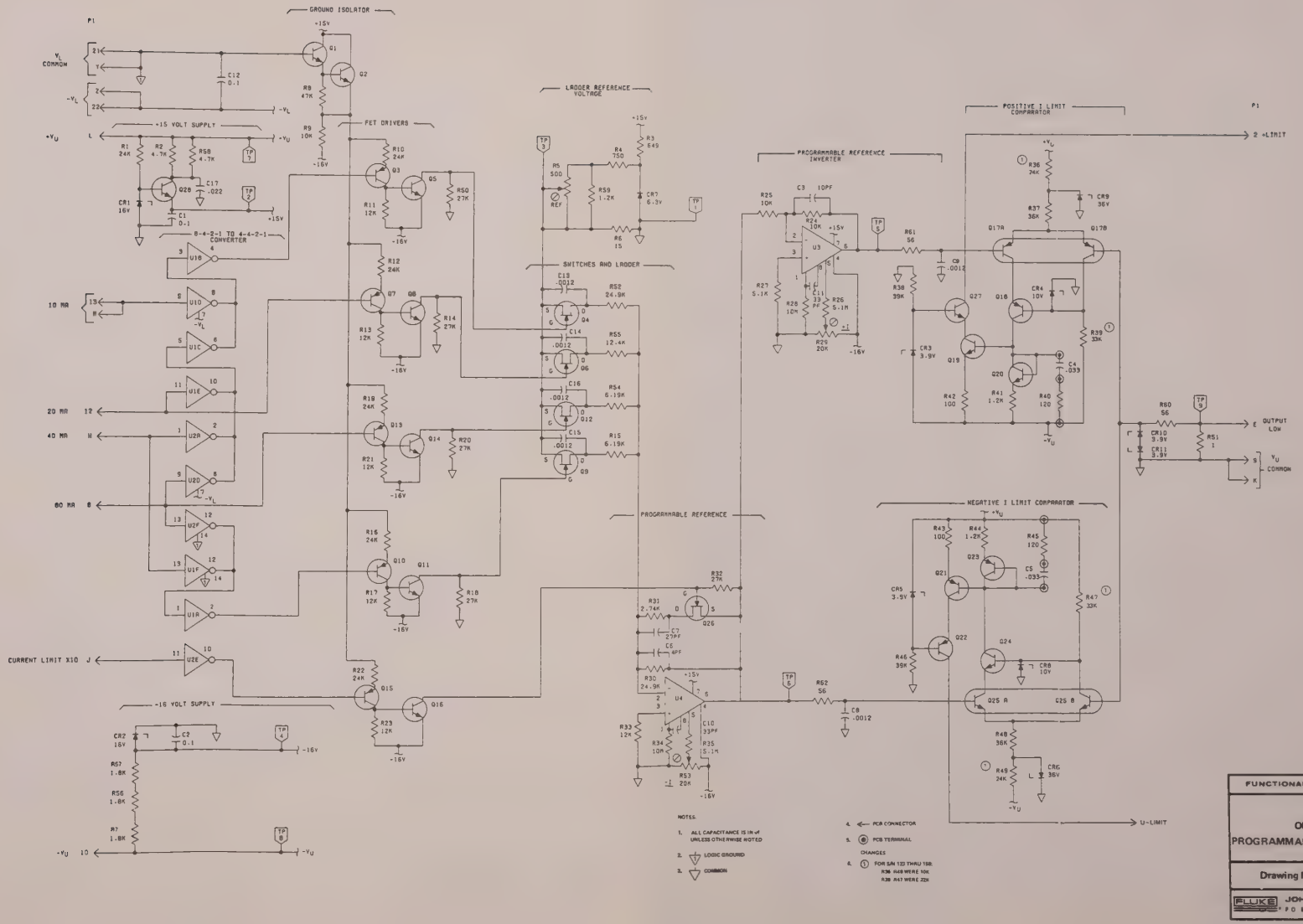
NOTE:
SEE SHEET 1 OF 2 FOR APPLICABLE NOTES AND JUMPER CONNECT DIAGRAM.

REV	DESCRIPTION
1	INITIAL PRODUCTION

A6 ISOLATED CONTROL LOGIC

4275A-1021

DATE	FEB. 1973	SHT 2 OF 2



FUNCTIONAL SCHEMATIC DIAGRAM

A8
OPTION -06
PROGRAMMABLE CURRENT LIMITER

Drawing No. 4250A-1081 REV b

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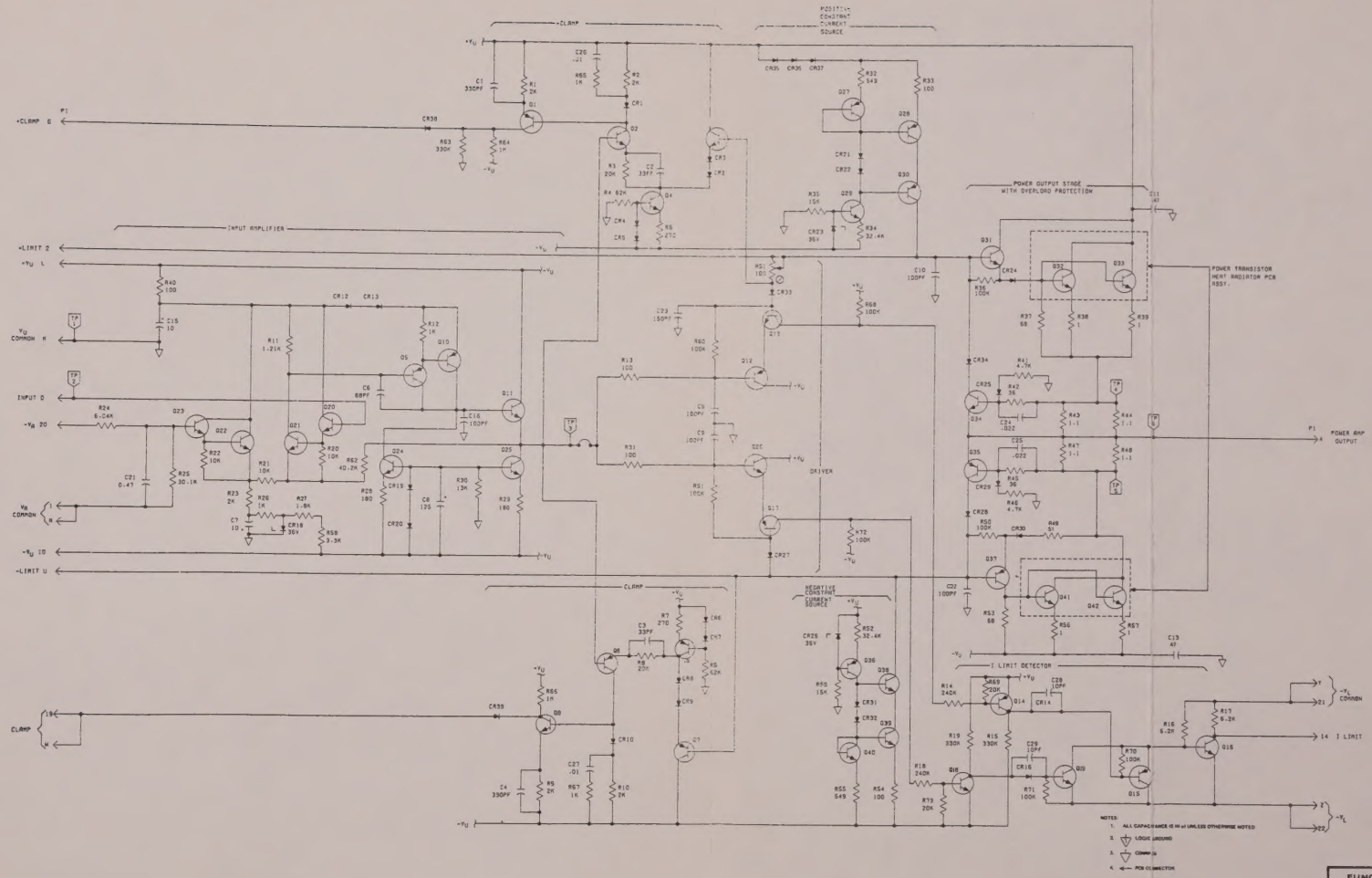
P.O. Box 7428 Seattle Washington 98133



FUNCTIONAL SCHEMATIC DIAGRAM

A9

POWER AMPLIFIER

Drawing No. 4250A-1071 REV b

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